Issued: February 21, 2007

Southwest Climate Outlook

The University of Arizona.

Source: Mike Crimmins, UA Cooperative Extension

Photo Description: Despite the rare snowstorm that hit Tucson last month (pictured above), most of Arizona is reporting less than 75 percent of average snowpack. However, these amounts are still far more than last winter's record dry season.

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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February Climate Summary

Drought – Drought conditions persist in Arizona due to below-average precipitation so far this winter while most of New Mexico remains drought-free.

Temperature – Over the past month, temperatures in the Southwest have been 3–6 degrees F cooler than average.

Precipitation – Precipitation has been below average in western Arizona but above average in most of New Mexico during the past month.

Climate Forecasts – Temperatures are expected to be warmer than average for most of the Southwest through August, while precipitation forecasts call for equal chances of below-average, average, or above-average precipitation.

El Niño – The current El Niño event is declining and a return to ENSO-neutral conditions is expected later this spring.

The Bottom Line – With the rapid decline of El Niño conditions in the tropical Pacific, forecasters are no longer predicting increased chances of above-average precipitation in the Southwest.

Winter precipitation favors New Mexico

Arizona has fared differently than New Mexico in terms of precipitation during this 2006–2007 winter season. In November, both states were warmer and drier than average, recording only 5–25 percent of average precipitation over most locations. A series of winter storms beginning in mid-December and continuing through January began to drive temperatures to several degrees below average. Most of the precipitation from these storms, however, affected more locations over New Mexico than in Arizona. Between November and January, most of Arizona recorded 50 percent or less of its average precipitation, and western Arizona remains at severe drought status. The drought status for New Mexico, on the other hand, has been lifted as a wet 2006 summer combined, with near-average to above-average precipitation, has improved conditions.

See U.S. Drought Monitor on page 8 for more info...

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Everybody counts when reining in global warming

What businesses and individuals can do to mitigate carbon dioxode emissions

By Melanie Lenart

Imagine a drier and warmer Southwest, a region in which heat waves, droughts and, paradoxically, floods become increasingly frequent, and snow cover dwindles. These projections, made by the world's leading climate scientists, suggest that climate change will hit the Southwest harder and sooner than some other areas of the country if global warming continues unchecked.

In the face of such a dire scenario, how can the average citizen possibly help? Certainly not everybody can afford to put solar panels on their roofs to reduce their contribution to global warming, but there are many ways individuals and businesses can reduce their impacts on climate. Purchasing carbon offsets from various groups, planting trees, driving less, adjusting the thermostat, and other individual efforts collectively add up to valuable cuts in the emissions that contribute to global warming.

Energy credits

For about $20 a month, the average American can eliminate greenhouse gas emissions, according to the Cool It! campaign, a carbon offset project run by a coalition of four groups (Figure 1). It sounds almost too good to be true, considering all of the problems associated with rising industrial greenhouse gas emissions and their role in global warming. Society's current production of greenhouse gases—mainly from the burning of gas, oil, and coal—is projected to boost Southwest temperatures about 0.7 degrees Fahrenheit a decade on average throughout this century. That rise brings a host of predictable changes, such as a reduction in snow cover and an increase in heat waves, as well as the potential for troublesome climate surprises.

A carbon offset investment, which varies by individual habits, allows people to virtually erase their greenhouse gas emissions, supporters say. Critics charge that the international carbon trading system and the U.S. adaptation of it create illusions about what needs to be done to reign in global warming.

The Cool It! campaign lets people offset their carbon emissions by supporting a 66-megawatt wind farm in southern California. The campaign gives people Renewable Energy Credit certificates (RECs), also known as green tags,for the energy produced when their money brings the generated wind energy down to market value, explained Julio Magalhães of the Sierra Club, one of the groups involved in the campaign.

"You're actually paying only this tiny cost difference, which is the difference between the price of coal versus wind," he said. A penny or two per kilowatt-hour can thus go a long way, explaining why the cost is relatively low. "For the price of a café latte per week, you can offset your carbon emissions," he added. The contributions are also tax-deductible.

In another effort to cut emissions, *Native*Energy, a majority tribally-owned company, uses contributions to support renewable energy, said Robert Gough, of the Intertribal Council on Utility Policy. The carbon offsets in this case count as green tags. *Native*Energy's efforts support the construction of new tribally-owned renewable energy projects that might not be built otherwise, Gough said.

"That money is there to finance renewable energy projects. The finance piece *Native*Energy brings is a significant factor in getting that project built," Gough said. For instance, offsets purchased by *Native*Energy covered about 25 percent of the hardware cost of a 750-kilowatt wind turbine on the Rosebud Sioux Reservation in South Dakota. Now the Rosebud Sioux Tribe is working out the final details of a 30-megawatt wind farm, also with support from selling green tags, he said.

Offset projects often sell credits based on the expected life span of the project. Putting up a windmill involves taking out a loan that requires operators to maintain the system for its expected life span, typically 25 years, Gough noted.

Many southwestern utilities allow their clients to support renewable energy by adding a surcharge to their bill, which in some cases is applied toward the purchase of solar energy from other customers. The U.S. Environmental Protection Agency (EPA) lists the utilities that provide this option on its Green Power website (see links on page 5).

But not everyone supports the concept of carbon offsets. At this stage, no national accounting system guarantees a carbon offset credit is sold only once or that it delivers what it promises, said Tom Goldtooth, the executive director of Indigenous Environmental Network and co-author of the 2006 book *Carbon Trading*.

"The elders said if there is something you can't translate, beware. How can you translate trading hot air?" he asked rhetorically during a December Tribal Lands Climate Conference held in Yuma, Arizona. Goldtooth directed his harshest criticism toward the international carbon trading market. "One of the concerns is that it provides no incentives for clean energy," he said.

Offset programs can give Americans a false sense that by writing a check, they can stop worrying about how much

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Reining in global warming, continued

they drive or use air-conditioning, he indicated. "The carbon trading culture continues to feed our addiction and doesn't address the issues of consumption."

Tree-planting projects can allow companies to gain carbon offset credits for planting monocultural plantations, including some that displace indigenous communities as well as native species, Goldtooth said. Also, there's no guarantee that forests will survive the length of some credits. Just as some groups will sell credits for the expected life span of a windmill, others will tally forestry credits by assuming each tree will survive for several decades. Yet if a forest goes up in flames, some of the carbon that was presumed offset goes up in smoke. Development could also take down some tallied trees. Neither the Cool It! campaign nor *Native*Energy includes carbon offset projects that involve tree-planting.

The power of plants

Global warming adds another challenge to the fate of some forests. Temperatures—and therefore evaporation rates—are rising. Changes in precipitation patterns remain mostly unpredictable, although the Intergovernmental Panel on Climate Change (IPCC) summary released February 2 projects that dry regions in general could get drier. Trees need relatively high moisture levels to survive, so lengthy droughts or shifts in wind and rain patterns could convert some forests into grasslands and deserts.

Plants and the ocean currently absorb about half the carbon dioxide emitted by fossil fuels globally. These natural systems also absorb the carbon dioxide released by worldwide deforestation. So plants, especially trees, can help curb global warming. Plants build their tissues from water and carbon dioxide. Using energy from sunlight, they transform these raw materials into carbohydrates that they use to survive and grow.

Sources of Emissions	Annual Carbon Dioxide Emitted	Monthly Cost to Offset
 Car Travel	10,900 lbs	$9.87
 Air Travel	1,500 lbs	$1.41
 Electricity Use	6,000 lbs	$5.42
 Natural Gas Use*	2,000 lbs	$1.82
Total:	20,400 lbs	$18.52

*Values are a bit higher for propane or heating oil use

Figure 1. The values above show what the average American contributes every year in carbon dioxide emissions from driving, flying, powering, and home heating, as tallied by the Cool It! campaign. Values do not include contributions from the manufacturing of products purchased, waste disposal, or other activities.

New Mexico forests capture about 21 million metric tons of carbon dioxide a year, while Arizona forests absorb an estimated 7 million, according to the respective states' Climate Change Advisory Group reports featured in last month's *Southwest Climate Outlook* article.

But when they burn, forests release some of that carbon dioxide. Arizona's forests, for example, released the equivalent of about 2.7 million metric tons of carbon dioxide during wildfires in 2002. (This value comes by applying IPCC and EPA conversion factors to emissions data collected by the Western Regional Air Partnership.) The estimate for how much carbon dioxide Arizona's forests absorb each year took wildfires into consideration, including the 2002 Rodeo-Chediski forest fire that burned 468,000 acres in the White Mountains.

Forest management practices can reduce the risk that a wildfire will reach into the treetops, which releases more carbon and kills more trees than a surface fire. Thinning out some of the trees can reduce the odds that a surface fire will explode into crown fires in southwestern forests, according to a study led by B.A. Strom of Northern Arizona University assessing damage from the Rodeo-Chediski fire. The wood from trees thinned out of forests can heat homes, schools, and businesses or provide electricity when burned. Forest Energy Corporation converts the thinned trees from White Mountain forests into pellets that burn clean

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Reining in global warming, continued

enough to use even on smog-alert days, explained Robert Davis, president of the Show Low, Arizona-based company.

Burning plant products has less impact on modern greenhouse gas levels than burning fossil fuels because of the time frames involved. The carbon from fossil fuels was captured millions of years ago, while the carbon from plants came from modern times. As long as the forest or farm that provided the plant products remains in place, new plants can start sequestering carbon all over again.

Carbon sequestration

In the context of managing greenhouse gases, carbon sequestration includes protecting forests and reforestation projects. Carbon sequestration also involves pulling carbon dioxide out of industrial emissions before they leave the smokestack and placing them into long-term storage.

Many policy analysts consider the sequestration of smokestack carbon essential, as the world's two biggest producers of greenhouse gases—the U.S. and China—both have centuries' worth of coal reserves to power electrical plants and industry. Coal emits almost twice as much carbon dioxide as natural gas to supply an equal amount of energy. At this point, it's expensive to sequester carbon, so few companies will embrace the practice without government incentives or mandates. So far this method has been restricted to small demonstration projects, but that could change in the near future. The U.S. Department of Energy plans to build a power plant that will gasify coal and capture all the plant's emissions for storage, while British Petroleum and General Electric are working together on a California power plant that will sequester carbon for long-term storage (*Science*, February 9).

Individual acts add up

When the carbon is tallied at the end of the day, individual acts to conserve energy count. Fortunately, saving energy often means saving money.

Among the largest contributors to greenhouse gases in the United States are vehicles. U.S. vehicles generate about half of the world's greenhouse gas emissions, according to a 2006 report by the Environmental Defense Fund. Driving smaller cars or hybrids, walking or biking, living closer to work, keeping tires full, or even lumping errands together for more efficient trips can help save gas, which translates into fewer emissions.

In the Southwest, heating water with the sun alone can work with a passive solar system. In summer, even conventional water heaters can be turned off if they're located in the outdoor sun. Washing clothes in cold water and installing low-flow shower heads and water-saving toilets all contribute to valuable savings. Turning down the thermostat in the winter and turning it up in summer generates savings. Similarly, choosing a swamp cooler over an air-conditioner is more energy-friendly and economical. Landscaping also cools the local environment via the water evaporated through plant leaves. Taller species can provide shade, perhaps even reducing home cooling costs. By using a permaculture approach, homeowners can conserve energy without increasing their water bills. (*Southwest Climate Outlook,* September 2006).

Using compact fluorescent light bulbs and turning off lights that aren't in use can cut down on energy use. Unplugging appliances contributes because most electronic devices continue to draw energy even when shut down. Recycling, buying fewer products, and using second-hand products also reduce energy consumption because of the emissions generated in the manufacturing industry.

In short, there is no replacement for individual action to conserve energy and reduce greenhouse gas emissions. Emissions add up household by household, car by car—and energy savings will too. With creative innovations for sequestering carbon, a willingness to support renewable energy, recognition of the value of plants, and many small efforts by individuals, this country can begin to reign in global warming. The time to act is now, before our climate changes into something unrecognizable that will make even seasoned southwesterners wonder how to handle the heat.

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

Helpful Links

Green Power Locator
http://www.epa.gov/greenpower/locator/index.htm

***Native*Energy**
http://www.nativeenergy.com/

Green-e
http://www.green-e.org/

Climate Neutral
www.climateneutral.com/

Carbon Trading: A Critical Conversation on Climate Change, Privatization and Power
www.dhf.uu.se

More ideas on Taking Action
http://www.climatecrisis.net/takeaction/

Forest Energy Corporation
http://www.forestenergy.com/

Intergovernmental Panel on Climate Change summary
http://www.ipcc.ch/SPM2feb07.pdf

Temperature (through 2/14/07)

Source: High Plains Regional Climate Center

Since the water year began October 1, the coldest temperatures with averages below 35 degrees Fahrenheit occurred across northern Arizona and along the Continental Divide to northern New Mexico (Figure 1a). The warmest average temperatures above 60 degrees F were recorded in the lower Colorado and Gila River valleys in Arizona. Temperatures throughout the Southwest have been mostly within 2 degrees F of the average during this water year (Figure 1b). However, in New Mexico the El Morro National Monument area south of Gallup and the Estancia-high plains area southeast of Albuquerque have been 2–6 degrees F below average. The past month has been cooler than average over the Southwest in general (Figure 1c). Average temperatures of 3–6 degrees F below average were recorded in southeastern and eastern Arizona, along the Continental Divide in western New Mexico, and in the high plains of eastern New Mexico. Stations in the El Morro and the Estancia areas recorded temperatures 6–9 degrees below average for the past month (Figure 1d).

In mid-January a storm moved through the Southwest, keeping temperatures mostly below average through early February. On the morning of January 17, several locations in northern Arizona recorded temperatures down to -10 degrees F. The cold snap gave way to a ridge of high pressure and very warm air that moved into the region in early February. This brought 80-degree F temperatures to southern Arizona and significant snowmelt in the high mountains of the Southwest.

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 February 14, 2007) average temperature.

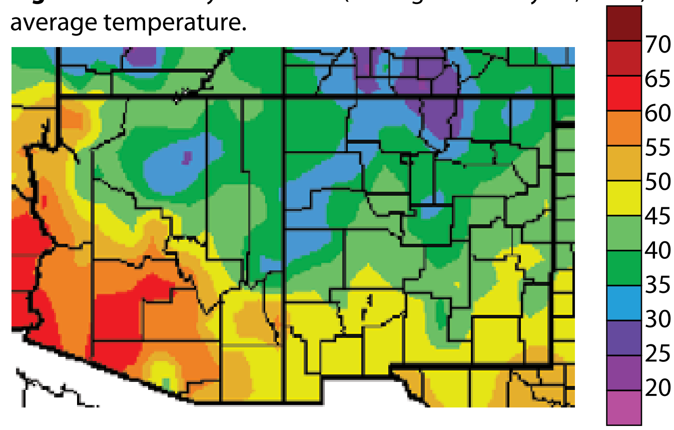


Figure 1b. Water year '06–'07 (through February 14, 2007) departure from average temperature.

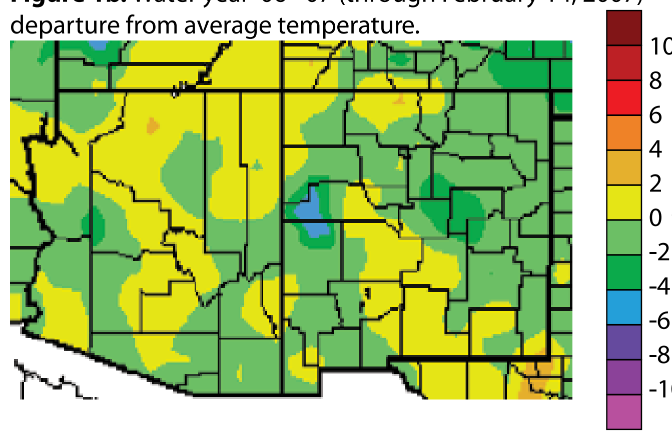


Figure 1c. Previous 30 days (January 16–February 14, 2007) departure from average temperature (interpolated).

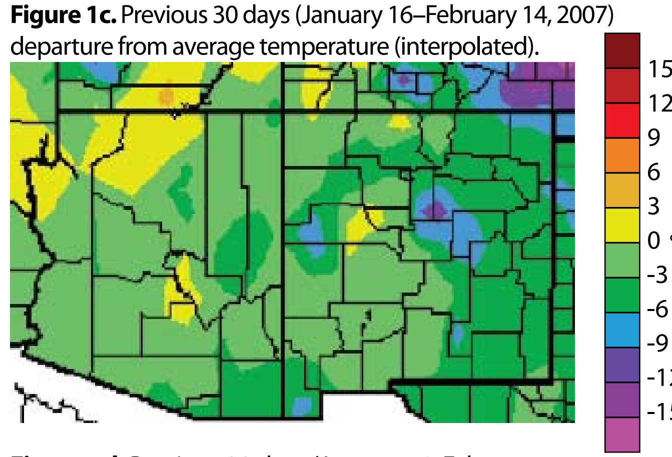
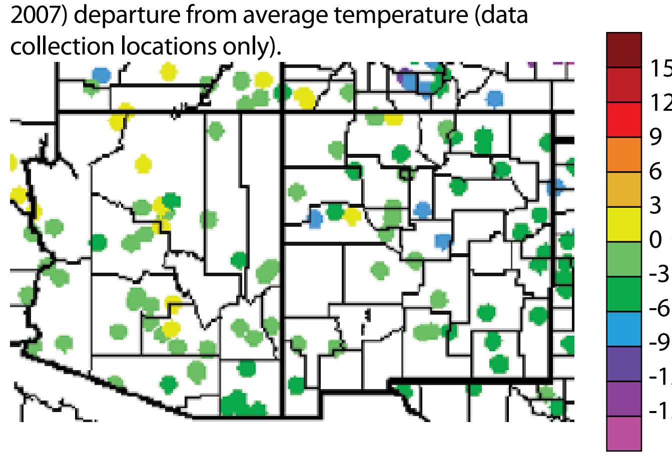


Figure 1d. Previous 30 days (January 16–February 14, 2007) departure from average temperature (data collection locations only).



Precipitation (through 2/14/07)

Source: High Plains Regional Climate Center

Precipitation in the Southwest has been generally below average in Arizona and above average in New Mexico so far during the water year (Figures 2a–b). One extreme is in the southwestern quarter of Arizona where this winter's recorded precipitation has been less than 25 percent of average. The other extreme makes up several areas of northern New Mexico where recorded precipitation has been 150–400 percent of average. During the past month, western Arizona has remained dry and recorded only 2–25 percent of average precipitation (Figures 2c–d). However, eastern Arizona has received substantially more precipitation, with some areas in the Painted Desert and along the Arizona-New Mexico state line recording 150–400 percent of average precipitation. Most of New Mexico has recorded over 150 percent of average precipitation. The highest departures in recorded precipitation in the past month have been 200–400 percent of average in eastern and southern New Mexico and near Albuquerque.

A cold winter storm moved through the Southwest in mid-January, bringing light snow as far south as Tucson and Nogales in Arizona. This storm essentially missed western Arizona, but it improved drought conditions over northern Arizona. In mid-February, a warmer storm brought light rain to southern Arizona and a mix of snow and rain in northern Arizona. In New Mexico, an influx of cold air produced more snow, with over 4 inches falling in Albuquerque.

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 February 14, 2007) percent of average precipitation (interpolated).

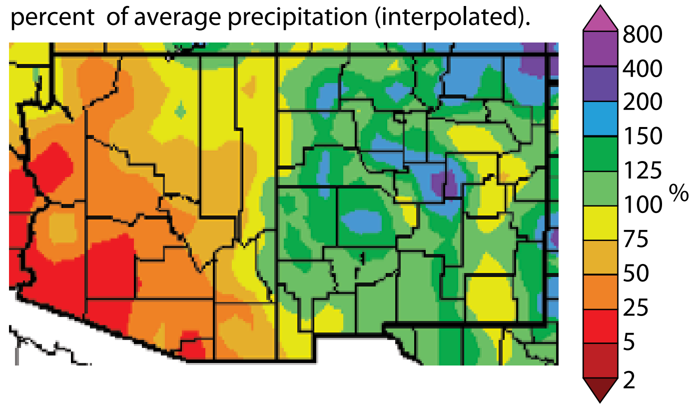


Figure 2b. Water year '06–'07 through (February 14, 2007) percent of average precipitation (data collection locations only).

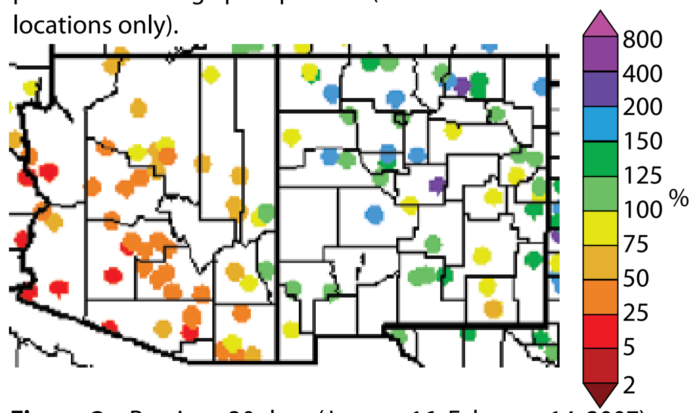


Figure 2c. Previous 30 days (January 16–February 14, 2007) percent of average precipitation (interpolated).

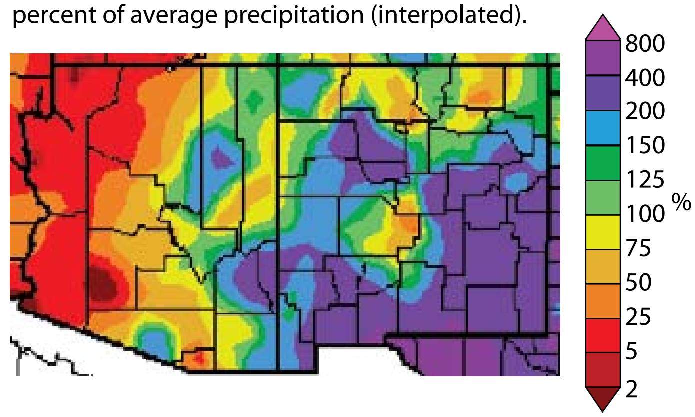
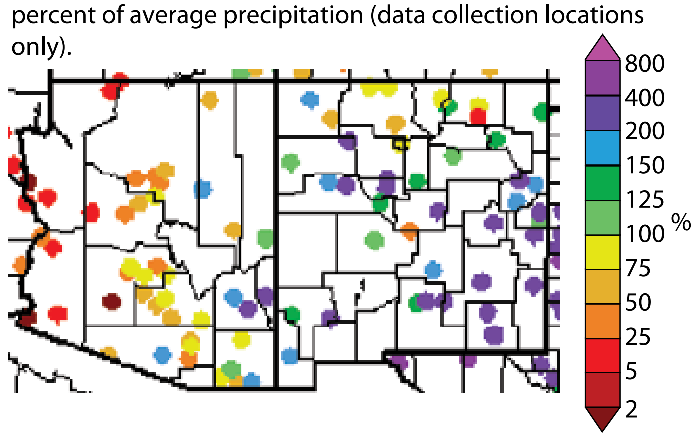


Figure 2d. Previous 30 days (January 16–February 14, 2007) percent of average precipitation (data collection locations only).



U.S. Drought Monitor

(released 2/15/07)

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

Nearly all of Arizona is experiencing some sort of drought, according to the edition of the U.S. Drought Monitor released on February 15, while most of New Mexico is drought free (Figure 3). Large areas in western and northern Arizona are classified as being in severe drought based on multi-year precipitation deficits. Along the Arizona-Utah border, in southeastern Arizona, and in northwestern New Mexico conditions are somewhat better and are classified as abnormally dry or normal. The rest of Arizona is experiencing moderate drought.

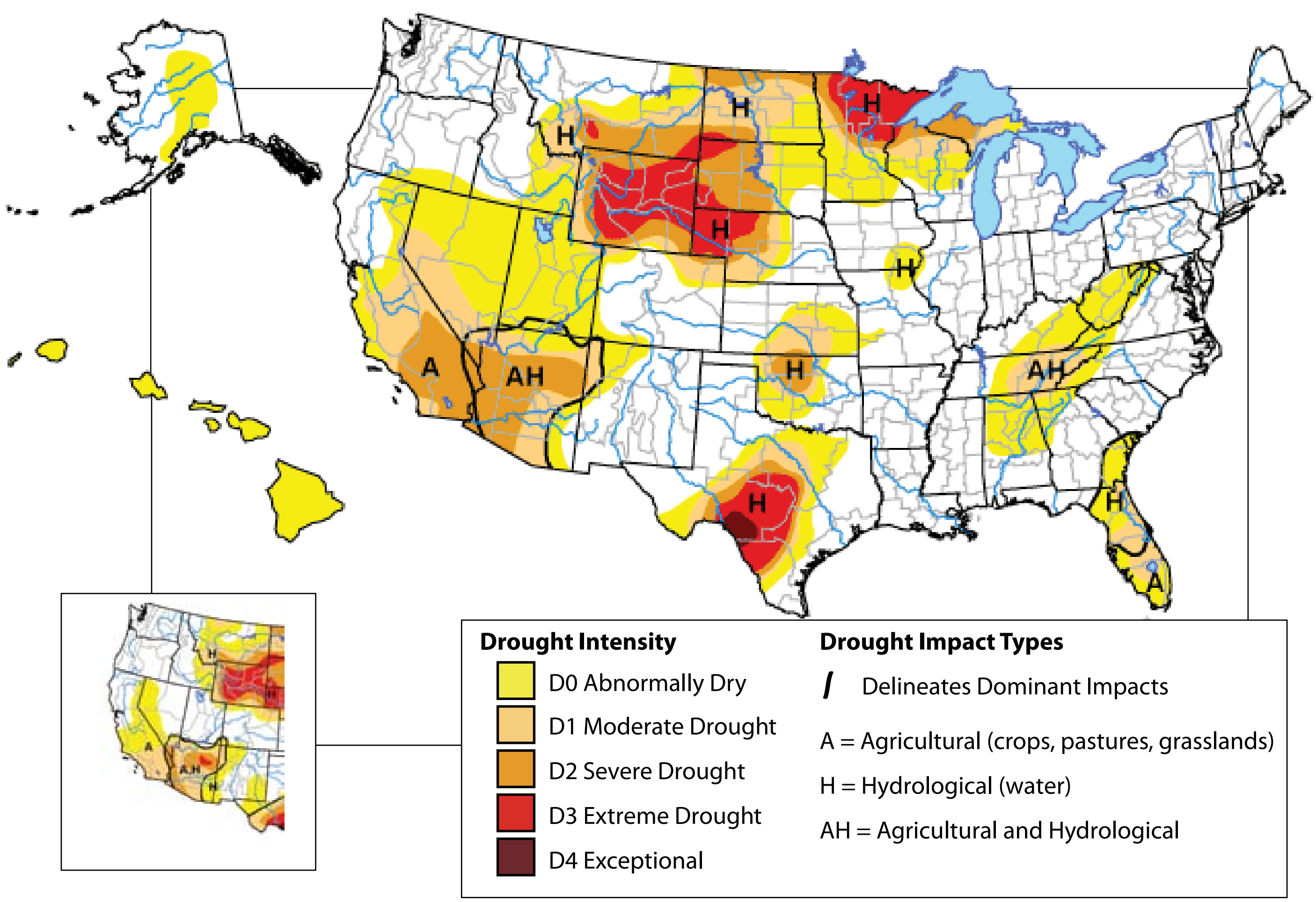
Compared with last month, drought status in north-central Arizona has improved from extreme drought, and the severe drought designation has expanded to include western Maricopa and more of La Paz and Mohave counties. The difference between Arizona and New Mexico drought status is related to the well above-average precipitation received across most of New Mexico over the winter and during last summer's thunderstorm season.

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 Richard Tinker, CPC/NOAA.

Figure 3. Drought Monitor released February 15, 2007 (full size) and January 18, 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 1/31/07)

Source: Arizona Department of Water Resources

Due to below-average precipitation during fall and early winter, the west central Arizona watersheds have been downgraded from moderate drought to severe drought relative to last month (Figure 4a). The Santa Cruz and San Pedro watersheds have also been downgraded to severe drought and abnormally dry status, respectively. All of Arizona is classified as being in some sort of short-term drought.

In the long-term, drought conditions have not changed significantly from last month (Figure 4b). The Willcox Playa watershed has improved somewhat and the southwestern watersheds continue to be near-normal. With precipitation forecasts now calling for equal-chances of below-average, average, or above-average precipitation, neither long-term nor short-term drought status is likely to improve dramatically in the near future.

Figure 4a. Arizona short-term drought status for January 2007.

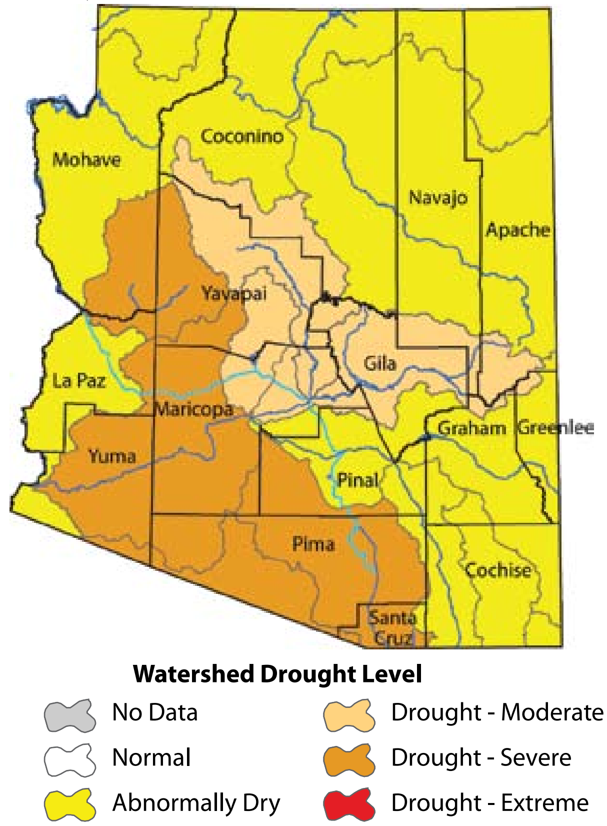
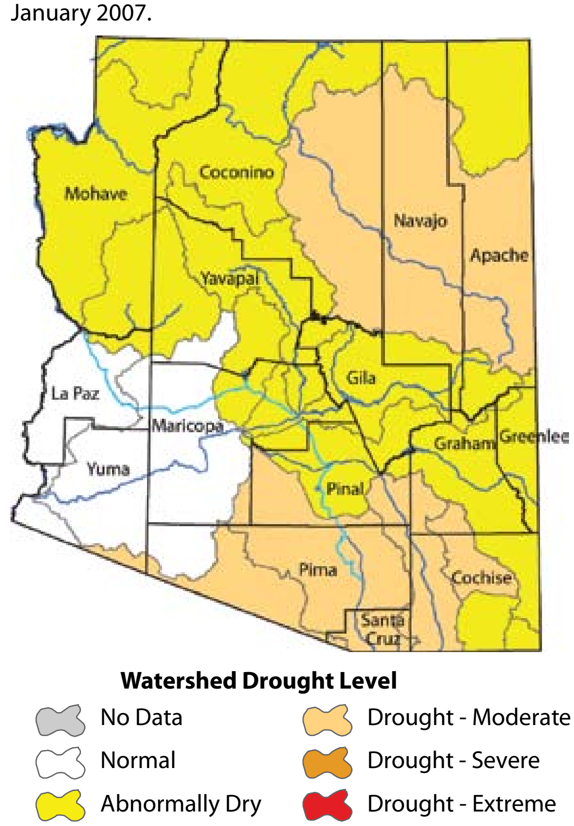


Figure 4b. Arizona long-term drought status for January 2007.



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/

New Mexico Drought Status
(through 2/28/07)

Source: New Mexico Natural Resources Conservation Service

Most of New Mexico is drought-free, based on short-term, meteorological conditions, according to the New Mexico State Drought Monitoring Committee (Figure 5a). Exceptions are areas in the west and north that have not received as much recent above-average winter precipitation. Most of the Arizona-New Mexico border is under advisory drought status, with areas in Sierra, Cibola, and McKinley counties in alert or warning status. Alert drought conditions also exist in Los Alamos County and parts of Rio Arriba, Sandoval, and Santa Fe counties. Relative to last month, areas in Sierra County have been upgraded from warning to alert status, while advisory conditions have expanded in Catron and Sandoval counties.

Long-term drought status is unchanged since last month, with most of the eastern and southern parts of the state in alert status. Northwestern and southwestern parts of the state remain in long-term advisory status (Figure 5b).

Figure 5a. Short-term drought map based on meteorological conditions for February 2007.

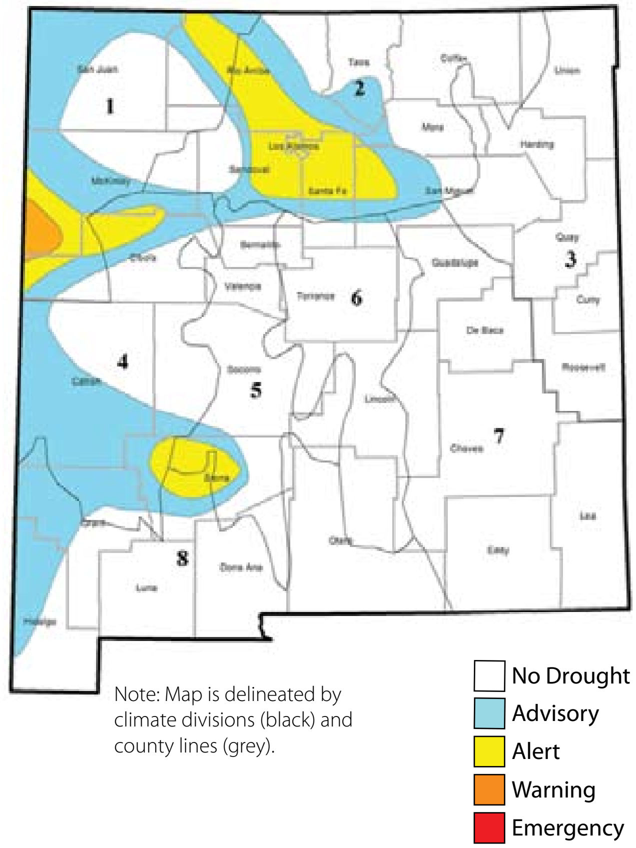
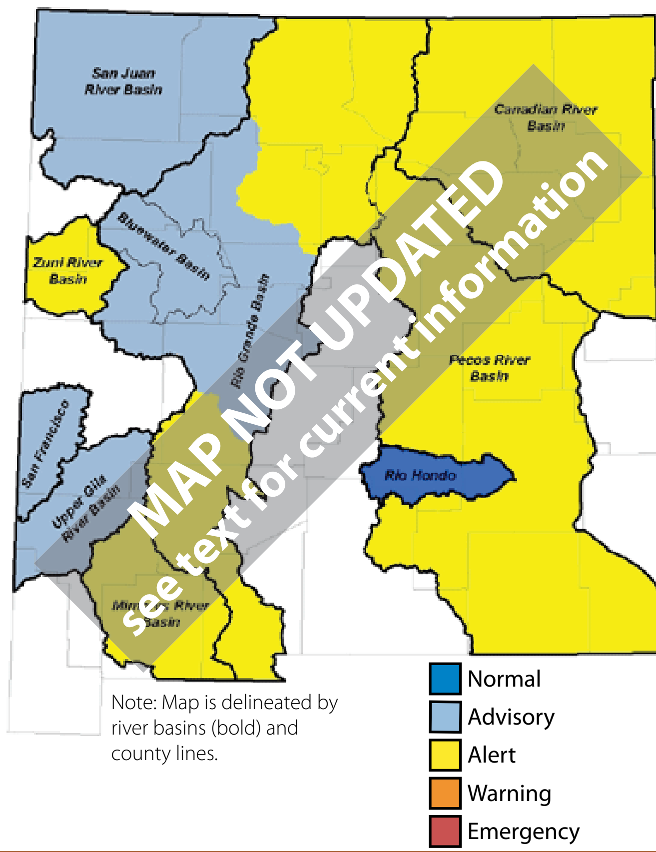


Figure 5b. Long-term drought map based on hydrological conditions for September 2006.



Notes:

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

Figure 5a shows short-term or *meteorological* drought conditions. Meteorological drought is defined usually on the basis of the degree of dryness (in comparison to some "normal" or average amount) over a relatively short duration (e.g., months). Figure 5b refers to long-term drought, sometimes known as *hydrological* drought. Hydrological drought is associated with the effects of relatively long periods of precipitation shortfalls (e.g., many months to years) on water supplies (i.e., streamflow, reservoir and lake levels, groundwater). This map is organized by river basins—the white regions are areas where no major river system is found.

On the Web:

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

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

Arizona Reservoir Levels

(through 1/31/07)

Source: National Water and Climate Center

Arizona reservoir levels remained relatively unchanged in comparison to last month (Figure 6). Lake Mohave had the largest relative gain (4.9 percent, 76.9 thousand acre feet) while Lake Verde's level dropped by 6.7 percent (5.2 thousand acre feet). Lake Mead, Lyman Reservoir, San Carlos, and the Salt River System also had modest increases while Lake Powell and Lake Havasu experienced moderate declines.

According to the U.S. Bureau of Reclamation, precipitation in the Upper Colorado River Basin was less than 50 percent of normal during January and basin-wide snowpack above Lake Powell is currently 75 percent of average. Unregulated inflow to Lake Powell for April–July is forecast to be 5.9 million acre-feet, or 74 percent of average.

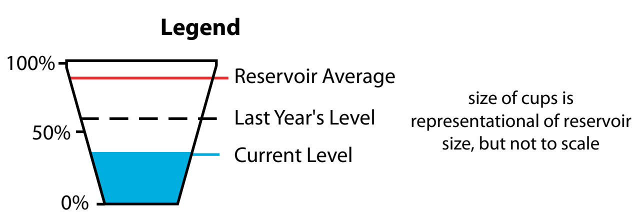
Notes:

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.

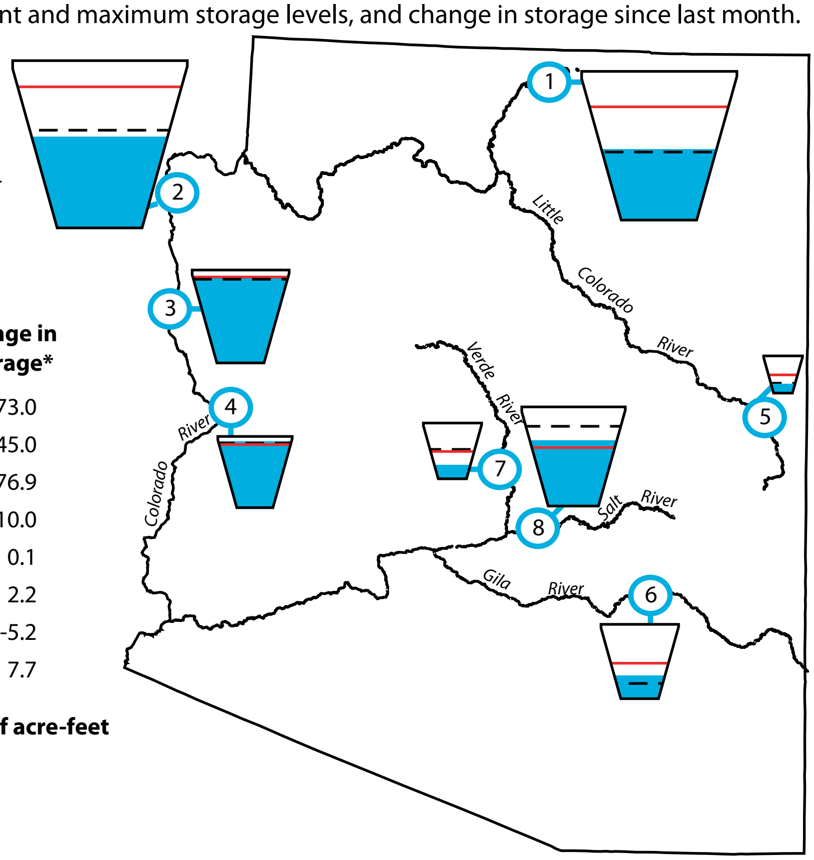
These data are based on reservoir reports updated monthly by the National Water and Climate Center of the U.S. Department of Agriculture's Natural Resource Conservation Service. For additional information, contact Tom Pagano at the National Water Climate Center (tom.pagano@por.usda.gov; 503-414-3010) 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 January 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%	11,703.0	24,322.0	-373.0
2. Lake Mead	55%	14,309.0	26,159.0	145.0
3. Lake Mohave	91%	1,656.0	1,810.0	76.9
4. Lake Havasu	93%	574.5	619.0	-10.0
5. Lyman Reservoir	25%	7.4	30.0	0.1
6. San Carlos	31%	272.5	875.0	2.2
7. Verde River System	25%	72.6	287.4	-5.2
8. Salt River System	66%	1336.9	2,025.8	7.7

*** thousands of acre-feet**



On the Web:

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

New Mexico Reservoir Levels

(through 1/31/07)

Source: National Water and Climate Center

Nearly all of New Mexico's reservoirs saw an increase in storage relative to last month (Figure 7). Elephant Butte experienced the largest gain in volume (8.4 percent, 43.1 thousand acre-feet), while Lake Avalon had the largest percentage change relative to last month (40 percent, 0.6 thousand acre-feet). The only reservoirs to decline from last month were Navajo Reservoir (-0.6 percent) and Heron Reservoir (-5.9 percent).

Above-average precipitation and snowpack in northern and eastern New Mexico this winter has contributed to reservoir levels. As snow begins to melt later this spring, reservoir levels could continue to increase.

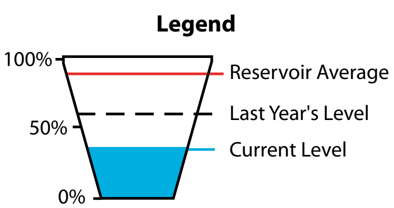
Notes:

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).

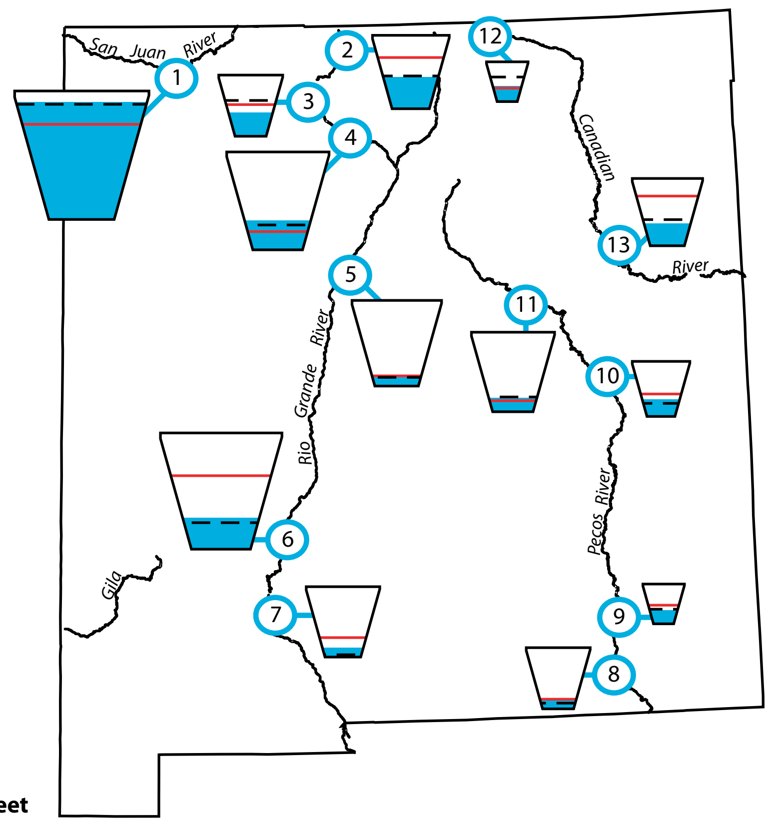
The table details more exactly the current capacity level (listed as a percent of maximum storage). Current and maximum storage levels are given in thousands of acre-feet for each reservoir. The last column of the table list an increase or decrease in storage since last month. A line indicates no change.

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 January 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.



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



Reservoir Name	Capacity Level	Current Storage*	Max Storage*	Change in Storage*
1. Navajo	91%	1,546.8	1,696.0	-8.9
2. Heron	43%	170.0	400.0	-10.7
3. El Vado	39%	73.1	186.3	3.3
4. Abiquiu	30%	166.7	554.5	9.7
5. Cochiti	10%	50.5	502.3	2.0
6. Elephant Butte	27%	557.1	2,065.0	43.1
7. Caballo	14%	45.2	331.5	2.1
8. Brantley	14%	20.0	147.5	3.8
9. Lake Avalon	35%	2.1	6.0	0.6
10. Sumner	31%	31.5	102.0	3.7
11. Santa Rosa	18%	79.8	447.0	0.9
12. Costilla	39%	6.2	16.0	0.5
13. Conchas	33%	84.7	254.0	1.1

*** 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

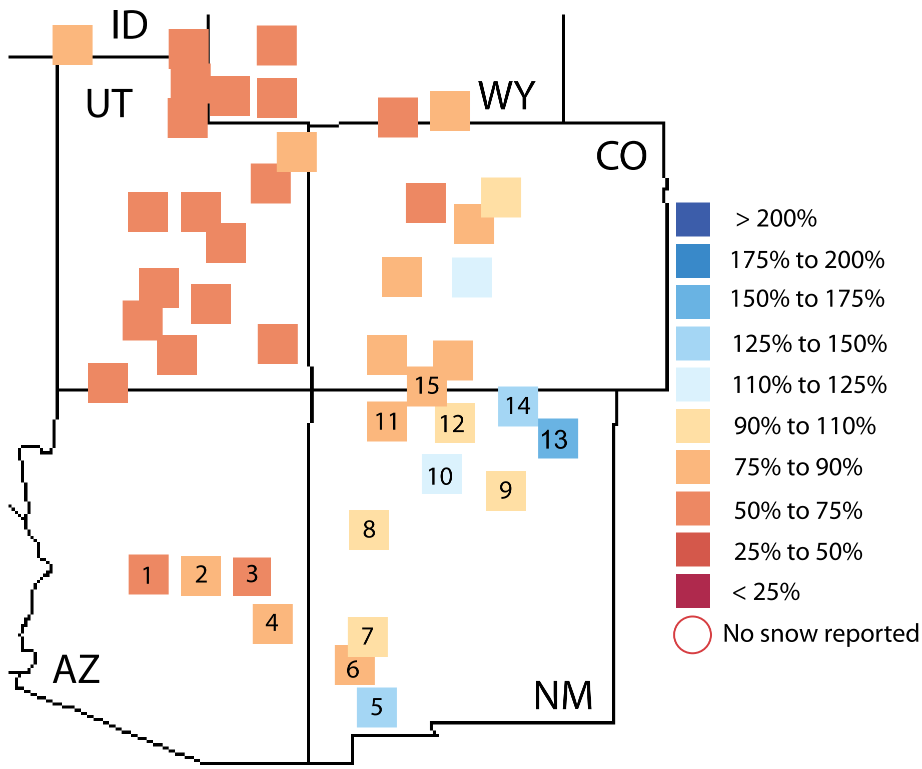
Southwest Snowpack

(updated 2/15/07)

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

Snowpack in most of Arizona and New Mexico has been below average this winter, with the exception of several sites in northern New Mexico including Jemez, Cimarron, and the Sangre de Cristo river basins (Figure 8). Most sites in Arizona report snow at less than 75 percent of average. Snowpack in Utah and Colorado is also below normal so far this winter and could translate to below-average inflow into the Southwest's reservoirs later this spring. Though this year's snowpack is below average, it is far greater than last winter's record dry season. This increased snowpack relative to last year may temper spring fire season severity later in the year, but will do little to alleviate long-term hydrological drought conditions.

Figure 8. Average snow water content (SWC) in percent of average for available monitoring sites as of February 15, 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

Temperature Outlook

(March–August 2007)

Source: NOAA Climate Prediction Center (CPC)

Temperatures throughout the Southwest are forecast to be above average through August 2007, according to NOAA-CPC predictions. Areas with highest probabilities (greater than 50 percent) of warmer-than-average temperatures are centered over the Arizona-Nevada-California border for the March–May forecast (Figure 9a). For the April–June period, this area expands to cover most of central and northwestern Arizona (Figure 9b). During the May–July forecast period, highest probabilities for above-average temperatures are over 60 percent and cover most of Arizona and southwestern New Mexico (Figure 9c). Nearly all of Arizona and New Mexico have at least a 50 percent chance of experiencing warmer-than-average temperatures, according to the June–August forecast (Figure 9d). These forecasts are primarily based on long-term warming trends observed in the region.

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 9a. Long-lead national temperature forecast for March–May 2007.

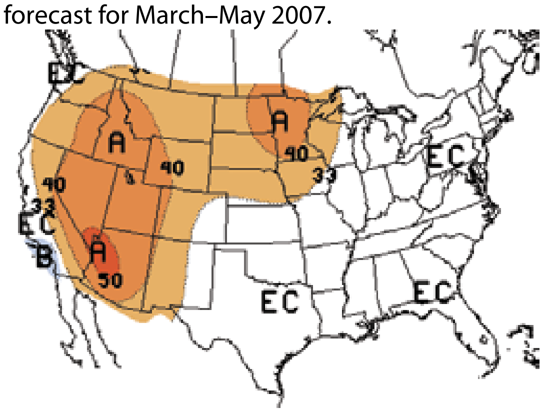


Figure 9b. Long-lead national temperature forecast for April–June 2007.

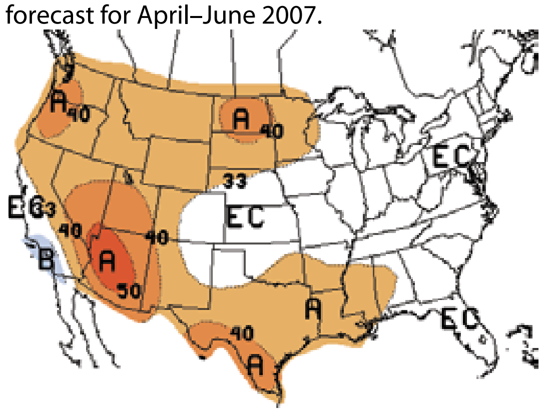


Figure 9c. Long-lead national temperature forecast for May–July 2007.

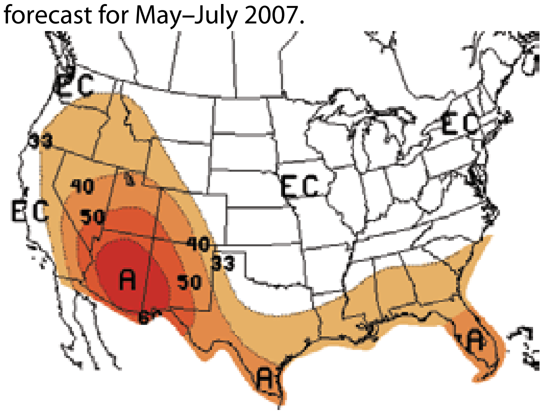
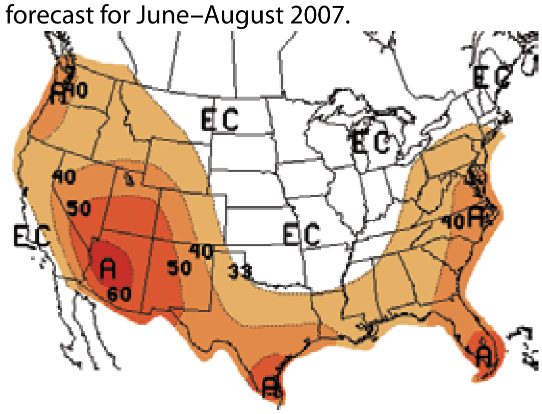


Figure 9d. Long-lead national temperature forecast for June–August 2007.



N= Near Normal: 33.3–39.9%; 40.0–49.9%

A= Above: 60.0–69.9%; 50.0–59.9%; 40.0–49.9%; 33.3–39.9%

EC= Equal chances. No forecasted anomalies.

On the Web:

For more information on CPC forecasts, visit:
http://www.cpc.ncep.noaa.gov/products/predictions/multi_season/13_seasonal_outlooks/color/churchill.html
(note that this website has many graphics and may load slowly on your computer)

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

Precipitation Outlook

(March–August 2007)

Source: NOAA Climate Prediction Center (CPC)

Precipitation forecasts from the NOAA-CPC predict equal chances of below-average, average, or above-average precipitation for most of the Southwest through August 2007. The March–May forecast indicates increased chances for below-average precipitation in northwestern Arizona and increased chances for above-average precipitation in most of New Mexico (Figure 10a). The other forecasts call for equal-chances except for portions of extreme northern Arizona and New Mexico. Previously issued forecasts have all called for increased chances of above-average precipitation in the Southwest associated with El Niño conditions. Due to the recent deterioration of the 2006-07 El Niño event (see Figure 13), these forecasts have been adjusted.

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 10a. Long-lead national precipitation forecast for March–May 2007.

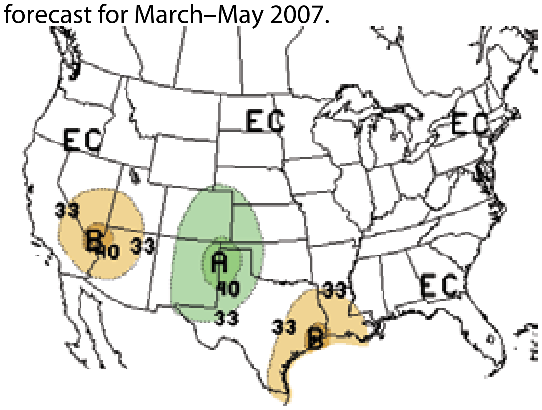


Figure 10b. Long-lead national precipitation forecast for April–June 2007.

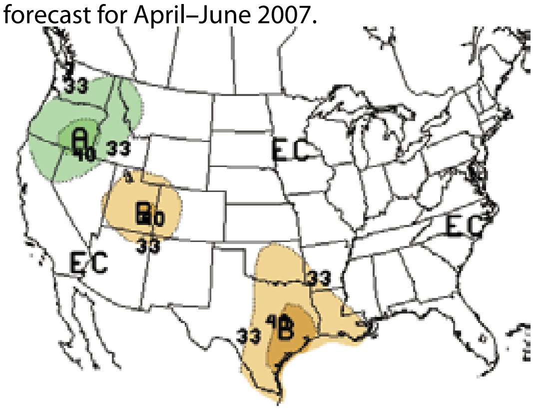


Figure 10c. Long-lead national precipitation forecast for May–July 2007.

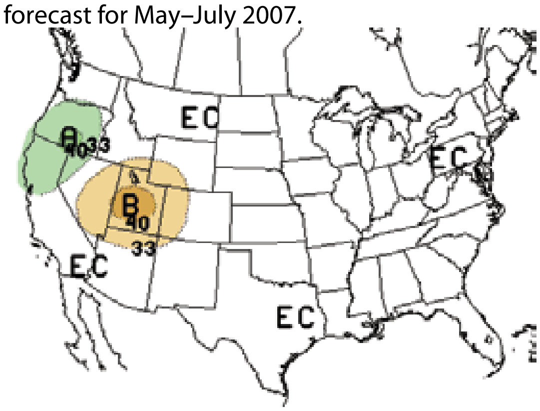
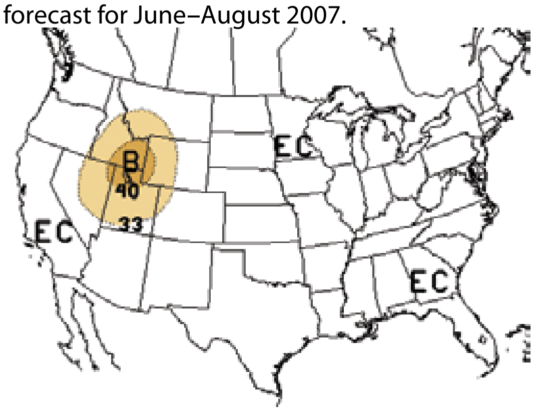


Figure 10d. Long-lead national precipitation forecast for June–August 2007.



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 May 2007)

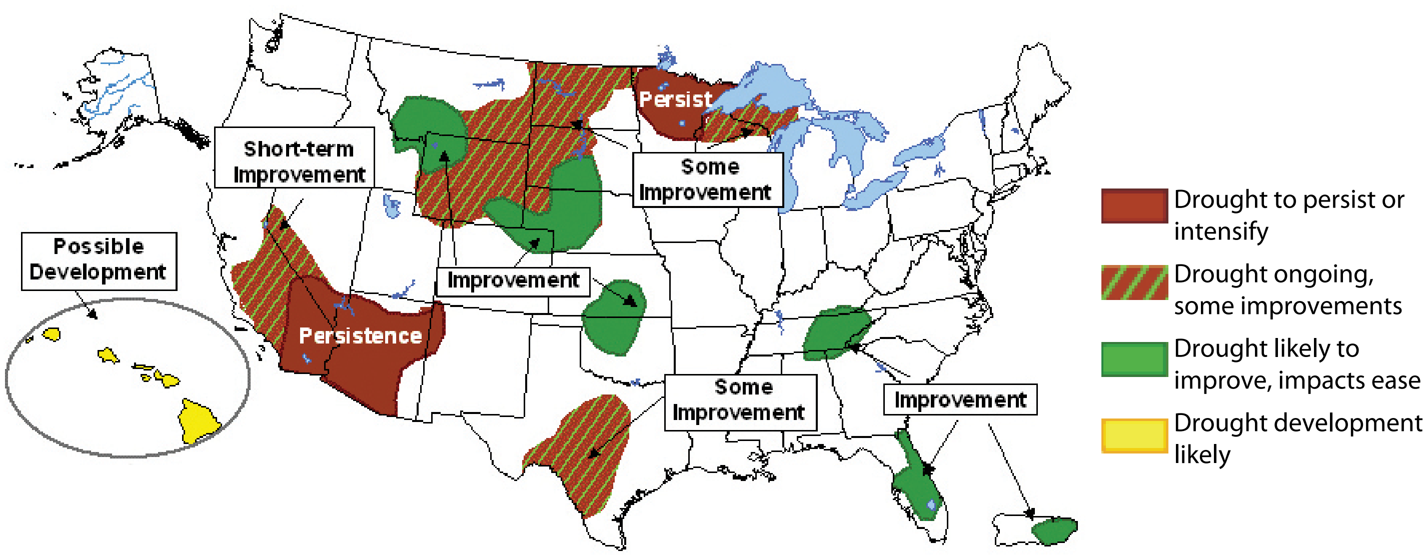
Source: NOAA Climate Prediction Center (CPC)

According to the U.S. Seasonal Drought Outlook, drought conditions are expected to persist in most of Arizona through May 2007 (Figure 11). With the decline of El Niño conditions (see Figure 13) and precipitation forecasts no longer calling for increased precipitation (see Figure 10), dry conditions are likely to remain. Predicted warmer-than-average temperatures in the Southwest could also exacerbate current drought conditions. Elsewhere, drought conditions are forecast to remain in northern Minnesota while some improvement is likely in central Texas, the northern Rockies and Great Plains, Florida, and eastern Tennessee.

Notes:

The delineated areas in the Seasonal Drought Outlook (Figure 11) are defined subjectively and are based on expert assessment of numerous indicators, including outputs of short- and long-term forecasting models.

Figure 11. Seasonal drought outlook through May 2007 (release date February 15, 2007).



On the Web:

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

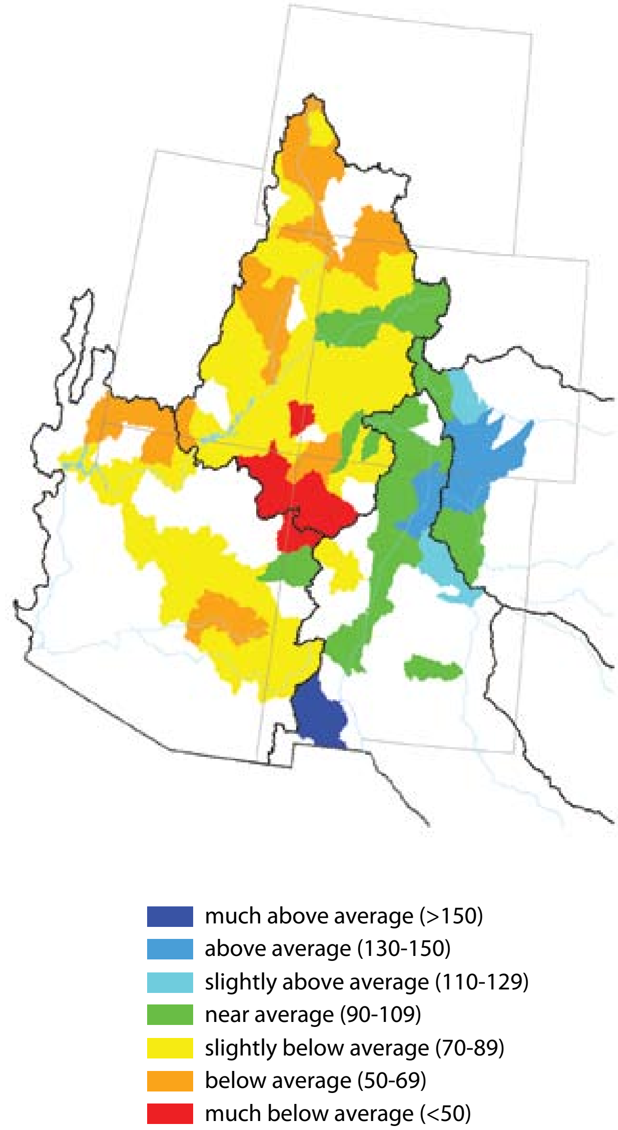
Streamflow Forecast
(for spring and summer)

Source: National Water and Climate Center

Streamflow forecasts predict flows much below average for rivers in Arizona and New Mexico (Figure 12). Flow is predicted to be near average along the Colorado River and slightly above average in the Upper Colorado River Basin, where snowpack is below average. There is still time for snowpack, and therefore streamflow, to improve in the Southwest, but most recent precipitation forecasts call for equal chances of below-average, average, or above-average precipitation in the region (see Figures 10a–d). These precipitation forecasts are related to the recent decline of the El Niño event (see Figure 13).

Temperature predictions are also important for streamflow forecasts. Although warmer temperatures are predicted for much of the West this spring, future streamflow forecasts could be affected if observed temperatures are cooler than normal. Though streamflows are forecast to be below average, they are in better shape than during last year's record dry winter. Improved flow could decrease stress on surface water supplies, alleviate fire conditions, and improve vegetation health.

Figure 12. Spring and summer streamflow forecast as of February 1, 2007 (percent of average).



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

Notes:

The forecast information provided in Figure 12 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 12.

El Niño Status and Forecast

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

As of mid-February El Niño conditions are rapidly diminishing and there is a 60 percent probability of a return to ENSO-neutral conditions for February–April 2007, according to the International Research Institute for Climate and Society, (Figure 13b). The deterioration of the El Niño event is related to the decline of sea surface temperatures (SST) in the eastern tropical Pacific over the past month from resurgent easterly winds moving colder waters from east to west. SOI values also indicate a return to ENSO-neutral conditions with a value of -0.5 (Figure 13a).

With an expected return to ENSO-neutral conditions, the Southwest, and particularly Arizona, is likely to miss out on previously forecast above-average precipitation associated with El Niño events (see Figures 10a–10d).

Figure 13a. The standardized values of the Southern Oscillation Index from January 1980–January 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).

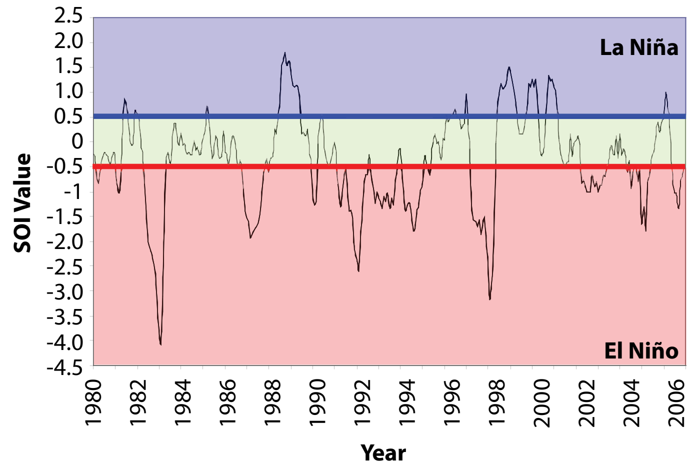
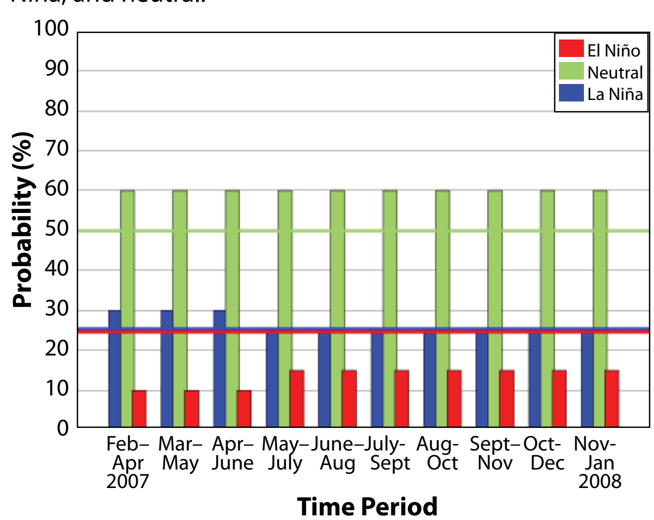


Figure 13b. IRI probabilistic ENSO forecast for El Niño 3.4 monitoring region (released February 15, 2007). Colored lines represent average historical probability of El Niño, La Niña, and neutral.



Notes:

Figure 13a shows the standardized three month running average values of the Southern Oscillation Index (SOI) from January 1980 through January 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 13b 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/

Temperature Verification
(November 2006–January 2007)
Source: NOAA Climate Prediction Center (CPC)

The NOAA-CPC long-lead national temperature forecast for November 2006–January 2007 predicted above-average temperatures for most of the West, the northern Great Plains, and the Great Lakes region. Regions with the highest likelihood predicted for above-average temperatures included the northern Great Plains, the Pacific Northwest coast, and the Southwest (Figure 14a). The West had many locations where observed temperatures were 2–8 degrees F below average (Figure 14b). These locations included central Nevada, central Utah, eastern Colorado, and western New Mexico. The observed temperatures for the northern Great Plains and the Great Lakes region were 4–10 degrees F above average. In New England, the temperature forecast predicted equal chances (EC) of below-average, average or above-average conditions. Observed temperatures, however, were 4–8 degrees F above average. The Pacific Northwest coast had observed temperatures near average within 2 degrees F.

Observed temperatures in the Southwest were near or below average, in contrast to the forecast. In November, observed temperatures were 2–4 degrees F above average and in December observed temperatures were near average. In January, however, observed temperatures were 3–9 degrees F below average with the greatest temperature departures from average observed in eastern New Mexico.

Figure 14a. Long-lead U.S. temperature forecast for November 2006–January 2007 (issued October 2006).

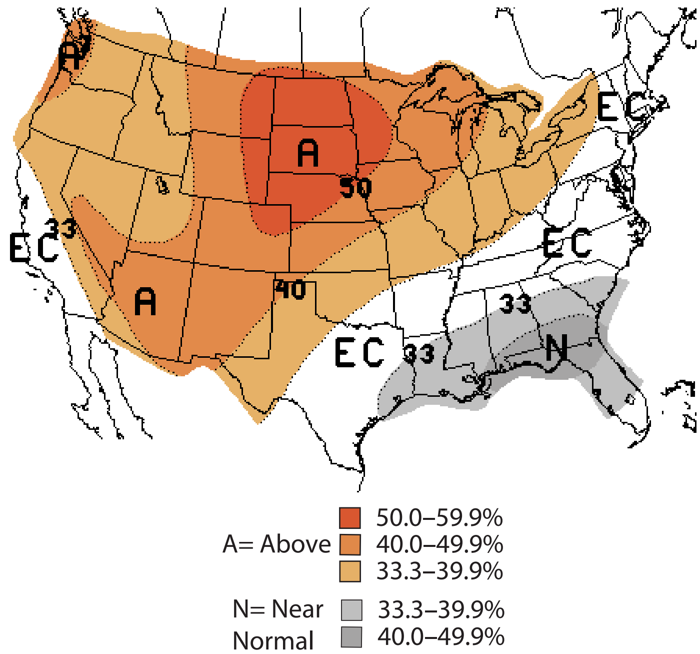
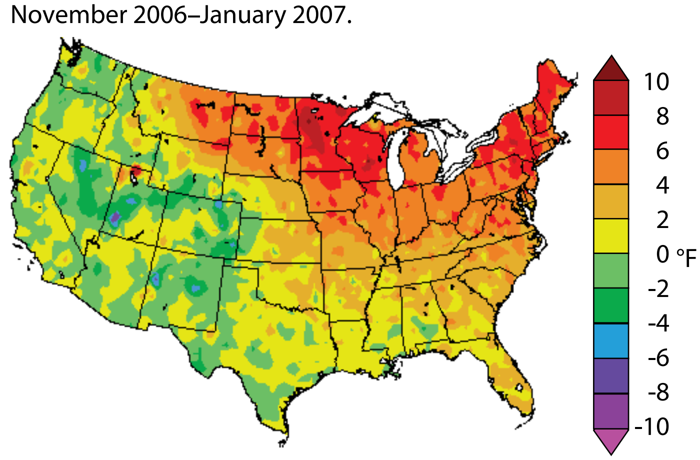


Figure 14b. Average temperature departure (in degrees F) for November 2006–January 2007.



Notes:
Figure 14a shows the NOAA Climate Prediction Center (CPC) temperature outlook for the months November 2006–January 2007. This forecast was made in October 2006.

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

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

Figure 14b shows the observed departure of temperature (degrees F) from the average for the November 2006–January 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.

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

(November 2006–January 2007)

Source: NOAA Climate Prediction Center (CPC)

The NOAA-CPC long-lead national precipitation forecast for November 2006–January 2007 predicted increased probabilities of below-average precipitation in the Pacific Northwest-northern Rocky Mountains and over the convergence of the Ohio and Mississippi rivers. There were increased probabilities of above-average precipitation for most of Texas including parts of the Southwest, and for parts of Florida, South Carolina, Georgia, and Alabama (Figure 15a). The observed precipitation differed from the forecasts over the Ohio-Mississippi river convergence, with recorded precipitation totaling 100-150 percent of average (Figure 15b). Observed precipitation also differed somewhat from the forecast in Florida and the far southeastern U.S., where 50–100 percent of average precipitation was recorded. In the Pacific Northwest above-average amounts of precipitation fell despite the below-average precipitation forecast for the area. However, in many areas over the northern Rocky Mountains, recorded precipitation totaled only 25–75 percent of average, matching the forecast for drier than average. The southern High Plains from western Nebraska to Texas recorded 150-400 percent of average precipitation. For West Texas, the observed above-average precipitation matched the forecast. In mid-December and mid-January, winter storms brought significant amounts of rain and snow to the Texas Panhandle. Eastern New Mexico observed above-average precipitation while the rest of the Southwest was drier than average.

Notes:

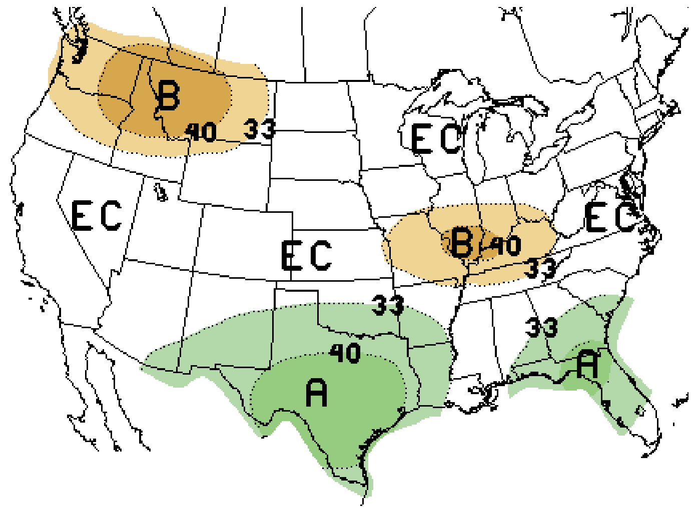
Figure 15a shows the NOAA Climate Prediction Center (CPC) precipitation outlook for the months November 2006–January 2007. This forecast was made in October 2006.

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

Figure 15b shows the observed percent of average precipitation for November 2006–January 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.

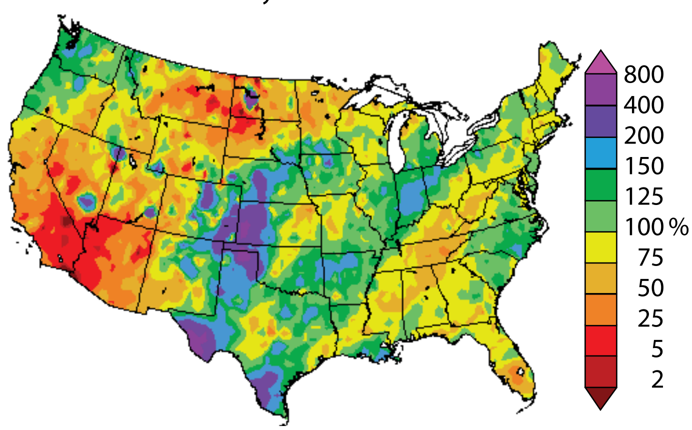
Figure 15a. Long-lead U.S. precipitation forecast for November 2006–January 2007 (issued October 2006).



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

EC= Equal chances. No forecasted anomalies.

Figure 15b. Percent of average precipitation observed from November 2006–January 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