

Southwest Climate Outlook

THE UNIVERSITY OF ARIZONA.



Source: Stephanie Doster, Institute for the Study of Planet Earth

Photo Description: A male desert tortoise makes his spring 2007 debut in Tucson. Emerging from his burrow in mid-March, he paused for a stiff drink, courtesy of a brief sprinkler shower.

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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Fire Summary → page 15

As of April 9, 2007, 402 fires have started in Arizona and New Mexico, burning a combined 25,451 acres. The majority of these fires have been human caused. Arizona and New Mexico report zero fires exceeding 100 acres burning as of April 20, 2007...

Fire Outlook → page 20

Wildland fire potential is forecast to be above normal in western Arizona, where long-term precipitation has been below normal. In eastern New Mexico, above-average precipitation last summer and this winter have contributed to a below-normal fire potential forecast...

El Niño → page 21

Current ENSO conditions are neutral, but current sea surface temperatures (SSTs) are below average in the eastern Pacific and along the coast of Peru, indicating increased chances for a return to La Niña conditions by mid-2007...

April Climate Summary

Drought – Drought conditions persist in most of Arizona, while New Mexico remains mostly drought free.

Fire Danger – Fire danger potential in most of the Southwest is forecast to be normal this spring, and fire activity is expected to be much less than last year.

Temperature – Temperatures in the Southwest have been above average except for areas in eastern New Mexico, which have been slightly cooler than average.

Precipitation – Precipitation was above average for much of New Mexico and most of central and southern Arizona due to the passage of several storm systems.

Climate Forecasts – Temperatures are forecast to be above average through October 2007, while precipitation forecasts predict equal chances of below-average, average, or above-average rainfall.

El Niño – Current ENSO conditions are neutral, and there is a 50 percent chance of La Niña conditions developing later this summer.

The Bottom Line – Recent precipitation has kept drought conditions from worsening in the Southwest, but streamflows and reservoir inflow are forecast to be below normal this spring due to below-average snowpack and early runoff from warm temperatures.

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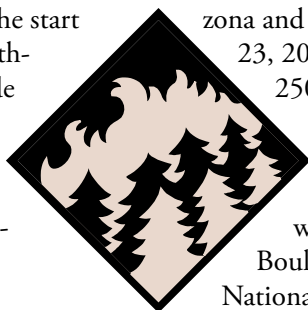
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Southwest Wildfire Season Outlook

April marks the return of the Southwest Fire Summary and Wildland Fire Outlook pages to the Southwest Climate Outlook. April is typically the start of the fire season in the Southwest, and these pages provide year-to-date fire information through maps, tables, and monthly fire potential forecasts, including information on fire fuel status.

Though still below average for many areas, winter and spring precipitation has helped suppress wildfires, and the



number of fires is down relative to this time last year. As of April 9, 402 fires have burned 25,451 acres in Arizona and New Mexico. As of April 23, 2006, 940 fires had burned 250,833 acres in Arizona and New Mexico.

Fire and climate experts will meet April 24–26 in Boulder, Colorado, at the National Seasonal Assessment Workshop (organized by CLIMAS), to assess fire potential and produce a national fire potential forecast.

For more information on fire, see pages 15 and 20...

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



Global warming in the Southwest: An overview

BY MELANIE LENART

Global warming will impact different regions and sectors in different ways, creating many losers and even a few winners around the world. Unfortunately, it looks like the Southwest will be on the losing side.

Losing water. Losing cool summer nights. Losing plant and animal species to changing climate patterns. Losing homes, forests, and Sonoran Desert to wildfires.

These are some of the impacts associated with the gains in temperature the Southwest has faced in recent decades—and is projected to continue experiencing for decades to come. The degree of the temperature rise will depend on whether society manages to curb the greenhouse gas emissions spurring on global warming.

The ways global warming and its associated climate changes are likely to affect the Southwest include higher temperatures, with more heat waves; more droughts and, paradoxically, more floods; less snow cover, with more strain on water resources; and an earlier spring with more large wildfires.

Many of these projected and sometimes already observed climate changes have been described in a series of *Southwest Climate Outlook* articles on global warming that ran from December 2003 through this month. The series has been pulled into a compilation, with additional contributions from other University of Arizona (UA) researchers. The book, *Global Warming in the Southwest* (GWS), is available at <http://www.ispe.arizona.edu/climas/pubs.html>. This article serves as an introduction to the book as well as an update on materials published since the articles were initially written.

The latest research papers and reports generally support the global warming

projections, observations, and impacts described in GWS. If anything, they heighten the cause for concern. The case for the Southwest facing extensive drought has gotten stronger. Similarly, more research concludes that the West faces future water shortages because of changing climate. The connection between hot weather and widespread tree die-off has been established more explicitly, as has the link between large wildfires and rising temperatures.

Temperature rise

The warming trend that took hold during the past century, particularly since the mid-1970s, has gotten even more entrenched since the article series started in 2003. The year 2005 went on to surpass 1998 as the world's hottest year in the instrumental record. By the end of 2006, the 10 hottest years on record all had occurred within the past 12 years, based on World Meteorological Association records from 1861.

It's unlikely that every year ahead will continue on this record-setting trend. A large volcanic eruption could cool things down globally for a year or two, as the Mount Pinatubo event in 1991 briefly slowed the temperature rise in the early 1990s. Annual variability could provide temporary relief. Overall, however, temperatures are expected to continue shifting upward throughout the century, as long as society continues to add heat-trapping greenhouse gases to the atmosphere.

The Intergovernmental Panel on Climate Change (IPCC) projects average annual temperature in the Southwest could rise by about 4½ to 7 or more degrees Fahrenheit during this century (*IPCC 2007 Summary for Policymakers*). More details about the IPCC projections, considered the most reliable because they involve the consensus of hundreds of scientists, will be released in May.

Arizona and New Mexico's average annual temperatures could both rise by 7 degrees Fahrenheit throughout this century, based on another projection that applies information from 18 global climate models to the climate division scale (*Southwest Hydrology*, January/February 2007). That amounts to roughly 1 degree Fahrenheit every 14 years. Summer temperatures could rise even more than winter temperatures by these projections, making parts of the Southwest even more intolerable between monsoon rains (see GWS, page 7).

A 1-degree Fahrenheit rise every 14 years may sound dramatic considering it took a whole century for the world's average annual temperature to rise by 1 degree. But this projected rate of increase is actually slightly slower than the rise Arizona experienced since the mid-1970s, and only slightly higher than the increase New Mexico registered in that time frame (Figure 1). These observed values include warming from the urban heat island effect as cities expand.

The number of extremely hot days is also projected to rise over the decades, leaving parts of the region with heat waves lasting an extra two weeks by the end of the century (*Proceedings of the National Academy of Sciences*, November 1, 2005). Hot summers boost the demand for water and electrical cooling (see GWS, page 69). Even worse, heat waves can create health risks, especially among the frail elderly and young children living in inner cities (*Environmental Health Perspectives*, May 2001).

Drought

Drought has further extended its grip on the Southwest in recent years, despite occasional excursions into times of plentiful precipitation, such as the winter of 2004–2005 and the summer of 2006. The latest projections for Southwest precipitation offer no relief in sight.

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GW overview, continued

The Dust Bowl years of the 1930s could become the new norm, based on results from 19 global climate models considered by Columbia University researcher Richard Seager and colleagues (*Science Express*, April 5, 2007). The projections suggest that the Southwest's immediate future would look much like the peak years of 2000–2003 in the Southwest's current drought. Things would only get worse in time, by this projection.

The IPCC also projects dry areas will get drier—in the Southwest and throughout the subtropics (*IPCC Summary for Policymakers*, 2007). This is a reversal of earlier projections in the 2001 IPCC summary that the Southwest might receive more rainfall as climate warms.

The mechanism behind the updated projection relates to a global atmospheric pattern known as Hadley Cell circulation (Figure 2). Globally, rising hot air from the tropics eventually descends in the subtropics. The high pressure of the descending air makes it difficult for clouds to form. This helps explain the seemingly endless supply of sunny days found in subtropical regions like the northern Africa, southern Australia and, of course, the U.S. Southwest.

The area under the Hadley Cell's descending air is projected to widen in years to come. As a result, the jet stream that transports rain and snow during winter and spring is expected to move poleward. In theory, the poleward pattern could mean El Niño events might often fail to bring hoped-for rain and snow to the Southwest. In practice, that pattern might look a lot like this past winter, when Denver received record snowfall while Arizona's dry winter pushed much of the state back into drought. This projection adds another element to the debate over the future of El Niño, one that was not addressed in the original article on page 17 of GWS.

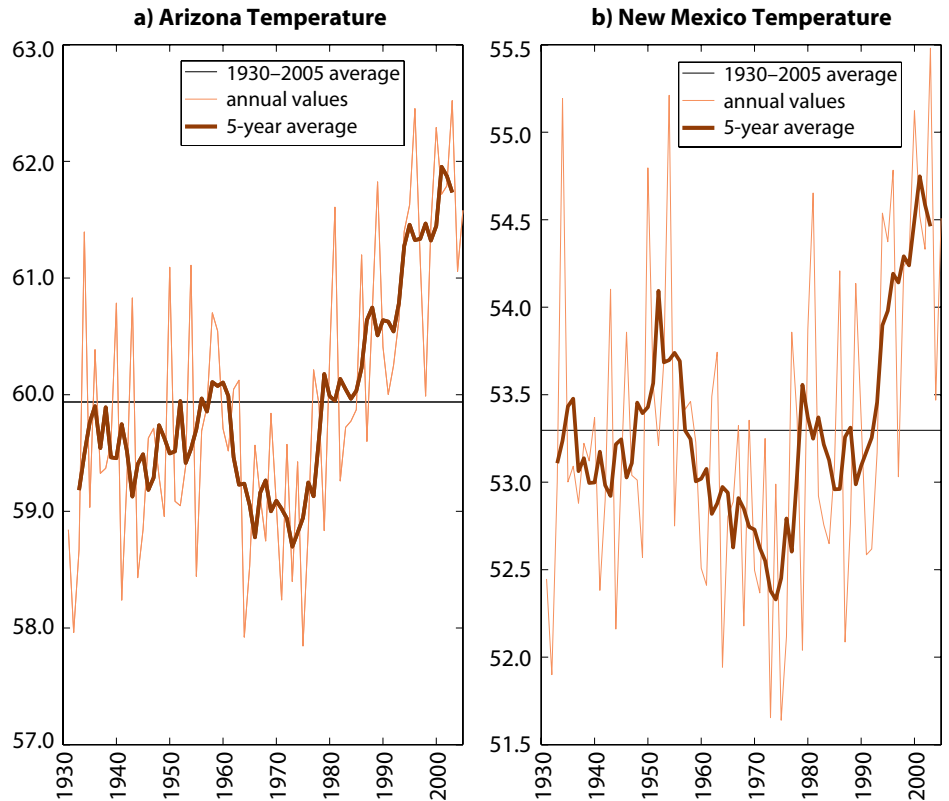


Figure 1. Southwest temperatures have been rising, above. Since 1976, the average annual temperature increased by 2.5 degrees Fahrenheit in Arizona a) and 1.8 degrees Fahrenheit in New Mexico b), or 0.8 degrees and 0.6 degrees Fahrenheit a decade, respectively. Data was averaged from the respective states' climate divisions by Ben Crawford, CLIMAS.

Floods

A more northerly jet stream in summer theoretically might make it easier for the monsoon to reach the Southwest, on the other hand. The jet stream can present a barrier to the monsoon's northward progression from its origin in tropical Mexico (see the two chapters starting on page 20 of GWS).

The monsoon operates at a scale smaller than that modeled by global climate models, making its future difficult to predict. No trend toward increased rainfall during the Southwest's monsoon season shows up in records for 1950–2001, but there are a few reasons to suspect the monsoonal rainfall tallies could increase as land and sea temperatures rise (see GWS, page 20). The projected shift in the jet stream could strengthen that case. A strong monsoon can increase the potential for flooding during this annual summer event.

However, even a strong monsoon generally does little to break long-term drought in the Southwest.

The stronger hydrological cycle that comes with global warming can produce seemingly paradoxical effects, including more drought and more floods. Southwestern springs, for instance, have been featuring both heavier rains and drier soils, based on a trend analysis of data from the past half century (*Journal of Hydrometeorology*, February 2004). Higher temperatures increase the atmosphere's ability to hold air moisture, as described in the climate regimes section of GWS. Evidence indicates this projected increase in air moisture and extreme precipitation events already is occurring globally, as noted in the 2007 *IPCC Summary for Policymakers*.

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GW overview, continued

The IPCC summary also acknowledges a correlation since the 1970s between rising sea surface temperatures and an increase in intense hurricanes in the Atlantic, and possibly in other regions, although it notes the data is less reliable for other parts of the world (see GWS, page 26). Remnants of hurricanes from the East Pacific affect the Southwest, as described on page 29 of GWS. These tropical storms can blanket the region with days of rain, increasing the risk of large-scale floods compared to the smaller scale monsoon thunderstorms.

Impacts on water supply

The growing consensus that the Southwest faces extensive drought in coming years leads to an increasing conviction that the region's water resources will be strained. The GWS chapters on water resources generally reflect that concern. However, two relevant publications worth noting have surfaced since then.

Researchers Martin Hoerling and Jon Eischeid of the National Oceanic and Atmospheric Administration (NOAA) paint a dire picture of future Colorado River flow (*Southwest Hydrology*, January/February 2007). The authors note that the Palmer Drought Severity Index (PDSI) explains nearly two-thirds of the variability in the Colorado's reconstructed natural flow near Lee's Ferry. They used the average of 18 global climate models to model future PDSI values, then applied these estimates to predict future river flow. They conclude the Colorado's annual flow could drop by half, on average, by about mid-century—dire news, especially considering that almost every drop of the river's current flow is already promised to somebody.

On a brighter note, two of the lead researchers whose 2004 paper had suggested the runoff trickling and streaming into the Colorado River might decline by an average of 16 percent in the coming century updated their results (see

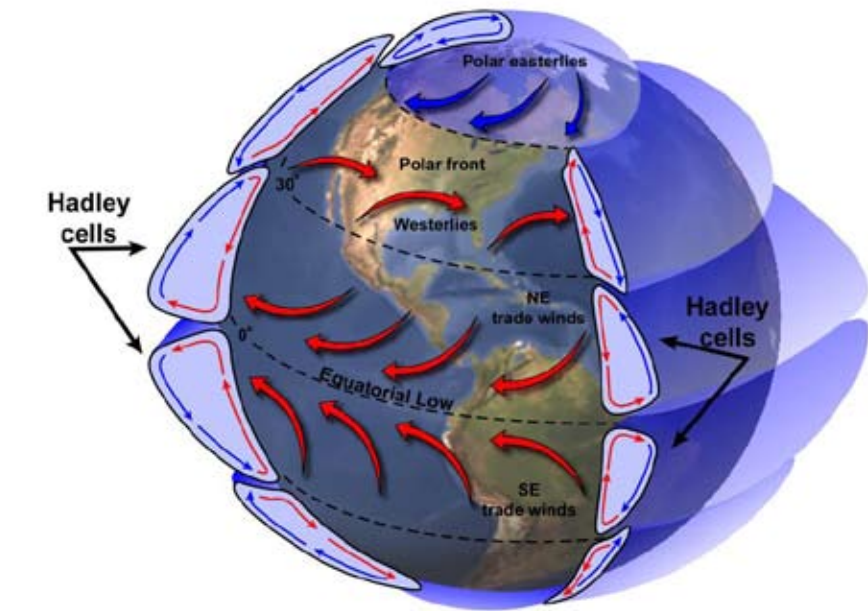


Figure 2. Hadley Cell circulation, above, illustrates how the rising air in the superheated tropics descends in the subtropics, which include the U.S. Southwest. The descending air creates high pressure zones that increase evaporation rates while restricting the development of clouds and rain. This circulation pattern is projected to intensify with global warming. Credit: Barbara Summey, NASA Goddard Visualization Analysis Lab

GWS, page 36). Their 2006 analysis has a somewhat more positive conclusion.

The paper by Niklas Christensen and Dennis Lettenmaier projected modest declines in Colorado runoff for the near future, through about 2040. By the end of the century, they projected the Colorado's flow would drop by 8 to 11 percent, depending on the IPCC emissions scenario used (*Hydrology and Earth Systems Sciences*, 2006).

"Everybody is consistent that there will be a downward trend, it's just a matter of how much," Lettenmaier elaborated in April, referring to theirs and others' latest projections.

The differences from the 2004 paper relate mainly to differences in seasonal precipitation in the Upper Colorado River Basin as projected by the climate models they employed, which they selected from the IPCC archive as appropriate models became available. While the 2004 climate model they used

projected a slight shift from winter to summer precipitation, the 2006 models projected a slight shift in the opposite direction, from summer to winter. Such seemingly minor differences have a major impact because the fraction of precipitation that ends up in streams and rivers is much higher in winter than in summer, Lettenmaier noted.

Impacts of warming temperatures on groundwater resources remain even more difficult to model or project than those on surface water supplies, but researchers worry about ongoing trends linked to snow cover decline (see GWS, page 39).

The earlier snowmelt that had been projected already has been observed at many western sites, as described in a 2005 article that documents how this change has been shifting the timing of rivers' peak flows forward in time throughout much of the West (*Journal of Climate*, April 2005). The fraction of precipitation falling as rain rather than

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GW overview, continued

snow also has increased, although some peaks in northeastern New Mexico have managed to evade this overall trend (*Journal of Climate*, September 2006). A January 2007 review article in the *Intermountain West Climate Summary* goes into more detail about recent research regarding western snow cover and water resources (for link, see box at right).

Landscape impacts

The telltale signs of spring, including melting snow, have been arriving earlier in time around the world (see GWS, page 56). The earlier arrival of spring could disrupt life cycles between paired species, such as plants and their pollinators, or birds and their prey. The premature snowmelt can allow soils to dry out sooner, increasing the risk of drought, insect invasions, and large wildfires.

Temperature has the potential to spur on wildfires for many reasons, some of which are described in the chapter starting on page 62 of GWS. In 2006, researchers reported that the number of large western wildfires tends to move up and down with spring and summer temperatures based on U.S. Forest Service and National Park Services data from 1970–2003 (*ScienceExpress*, July 6, 2006). The ground-breaking paper by Anthony Westerling and colleagues, including the UA's Thomas Swetnam, linked the earlier snowmelt during warmer-than-average springs and summers to an increase in large, western wildfires especially since the mid-1980s.

Researchers had also suspected high temperatures were linked to bark-beetle outbreaks that damaged more than 3.5 million acres of southwestern ponderosa and pinyon pines from 2001 to 2003 (see GWS, page 49). In 2005, UA researcher David Breshears and colleagues documented how high temperatures served as an underlying cause behind an extensive piñon die-off event in the Southwest (*Proceedings of the*

National Academy of Sciences, October 18, 2005).

Striving for sustainability

And now for the good news. As the evidence grows that the Southwest and the rest of the world face dire disruptions from global warming, politicians have joined scientists and activists to push for policy changes to reduce the greenhouse gas emissions behind the temperature rise and other chaotic climate changes.

Governments from local to state levels, including Arizona and New Mexico, are setting goals for reducing greenhouse gases emissions. The last section of the compilation describes some of these efforts, (as well as some things individuals can do to reduce their own contributions to global warming). Employing wind energy, solar power, energy and water conservation, water harvesting, and forest mitigation all can increase the odds that society will be able to weather global warming.

The move to renewable forms of energy can even help the economy, as the chapter in GWS on solar and wind energy illustrates. Regional efforts to tap into alternative energy markets might help restore some of the U.S. presence in the solar and wind markets. Currently, these forms of renewable energy are so popular around the world that production is not keeping up with demand.

The world market is gearing up for alternative energy production and other “green” business ventures. Also, companies have been reaping savings by pursuing conservation efforts. Recently Walmart has found that putting sky lights in some of its stores not only saved money on energy bills, it also improved profits. Judging from reports in publications from *The New York Times* to *The Economist*, businesses are increasingly finding that going greener speaks to the bottom line as well as the greater good.

Between the efforts of governments, individuals, and businesses, the U.S. public is starting to embrace the wisdom of reducing its collective greenhouse gas emissions. Increasingly, people are recognizing that stabilizing the global climate amounts to stabilizing the global economy. Americans release among the highest levels of greenhouse gases in the world, on both the per-capita and country level. So this country's efforts really can make a difference in how much the world warms in years to come.

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>

Related Links

Global Warming in the Southwest
<http://www.ispe.arizona.edu/climas/pubs.html>

Intermountain West Climate Summary
http://www.colorado.edu/products/forecasts_and_outlooks/intermountain_west_climate_summary/January_2007.pdf

Southwest Hydrology
http://www.swhydro.arizona.edu/archive/V6_N1/

Hydrological Earth Systems Science
paper by Christensen and Lettenmaier
<http://www.copernicus.org/EGU/hess/hessd/3/3727/hessd-3-3727.pdf>

“More Large Forest Fires Linked to Climate Change”
<http://uanews.org/spots/sci-12868.html>

“Underlying Cause of Massive Pinyon Pine Die-Off Revealed”
<http://uanews.org/spots/sci-11731.html>



Temperature (through 4/18/07)

Source: High Plains Regional Climate Center

Average temperatures across the Southwest since the beginning of the water year on October 1, 2006, have ranged from 60 to 65 degrees Fahrenheit along the lower Gila and Colorado River valleys to 25 to 35 degrees F in the mountains of northern New Mexico and Arizona (Figure 1a). From mid-December through January temperatures across the Southwest were mostly colder than average. However, November and March, at the beginning and end of the winter season, experienced above-average temperatures. Overall, average temperatures in northern and central Arizona and northern New Mexico have been 1–3 degrees F above average, but 1–3 degrees F below average in parts of western and eastern New Mexico and parts of western and southeastern Arizona (Figure 1b).

For the past month, most of Arizona and northwestern New Mexico have been 0–4 degrees F above average, with the greatest temperature departures of 4–6 degrees F above average in the northern part of the states (Figures 1c–1d). However, temperatures in eastern New Mexico over the past month have remained 2–4 degrees F below average. During the middle of March, record high temperatures occurred in Arizona hitting 95, 99, and 73 degrees F on March 17 in Tucson, Phoenix, and Flagstaff, respectively. The beginning of April also saw above-average temperatures; during mid-April, however, temperatures dropped to below average over much of the Southwest with the passage of spring storm systems.

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 April 18, 2007) average temperature.

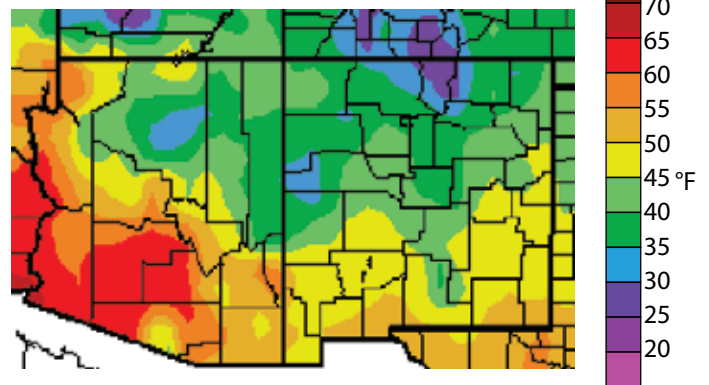


Figure 1b. Water year '06-'07 (through April 18, 2007) departure from average temperature.

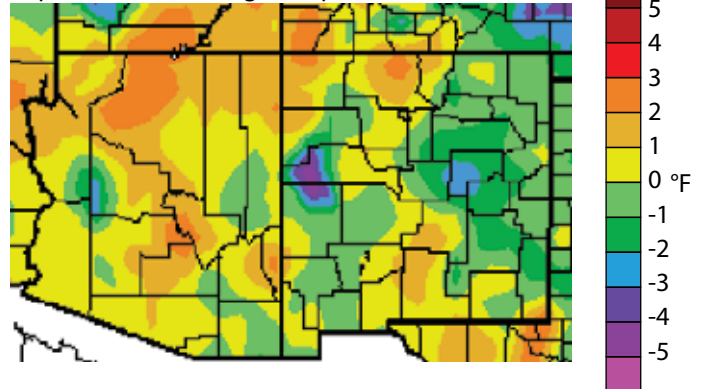


Figure 1c. Previous 30 days (March 20–April 18, 2007) departure from average temperature (interpolated).

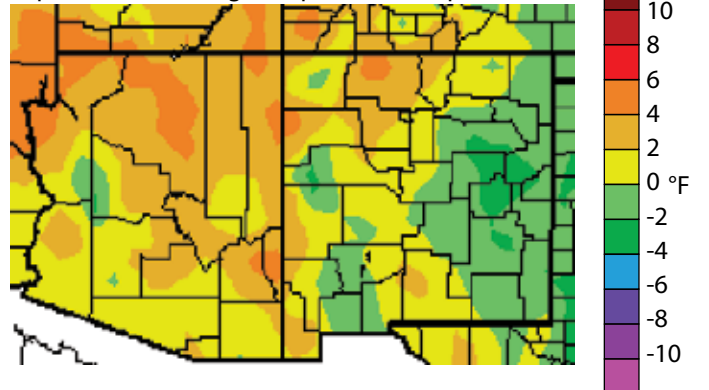
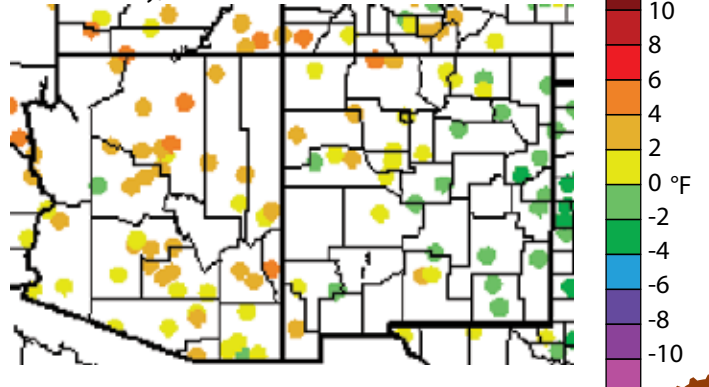


Figure 1d. Previous 30 days (March 20–April 18, 2007) departure from average temperature (data collection locations only).



Precipitation (through 4/18/07)

Source: High Plains Regional Climate Center

Since the beginning of the water year on October 1, 2006, much of Arizona has received only 25–70 percent of average precipitation, while most areas of New Mexico have received 90 to 200 percent of average precipitation (Figures 2a–2b). Although El Niño conditions persisted through the winter, the subtropical jet/storm track was just south of Arizona. Lows that passed the area brought moisture from the subtropical jet into New Mexico while Arizona was on the cool and dry side of these storms. These prevailing conditions changed to some extent in late March and mid-April, and both Arizona and New Mexico received some precipitation. During the previous thirty days, much of Arizona has received 100–400 percent of average precipitation, although parts of northern and northwestern Arizona received less than 2–50 percent (Figures 2c–2d). Much of New Mexico has received at least 150–800 percent of average precipitation; however, the southern Rio Grande Valley around Las Cruces, New Mexico, and El Paso, Texas, has received less than 5–50 percent.

The spring months of April and May are climatologically dry in the Southwest. However, late March and early April brought precipitation in between periods of warm weather. Given the additional precipitation in April, New Mexico has remained relatively drought free for the most part, while the precipitation received in Arizona has prevented drought conditions from getting worse in the short-term.

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 April 18, 2007) percent of average precipitation (interpolated).

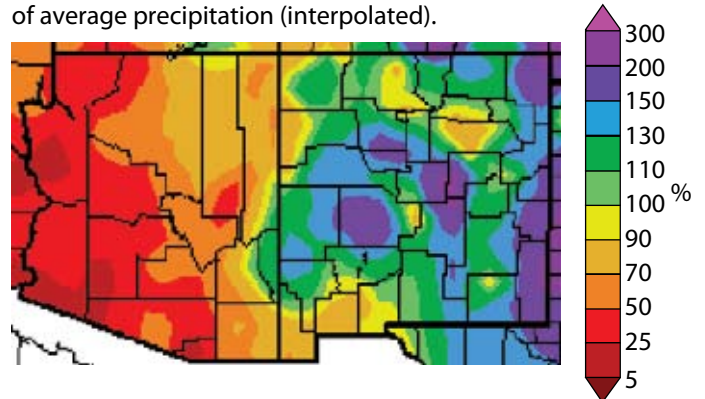


Figure 2b. Water year '06-'07 (through April 18, 2007) percent of average precipitation (data collection locations only).

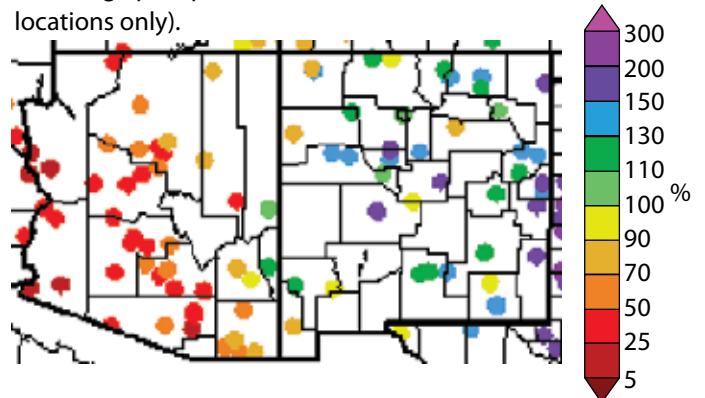


Figure 2c. Previous 30 days (March 20–April 18, 2007) percent of average precipitation (interpolated).

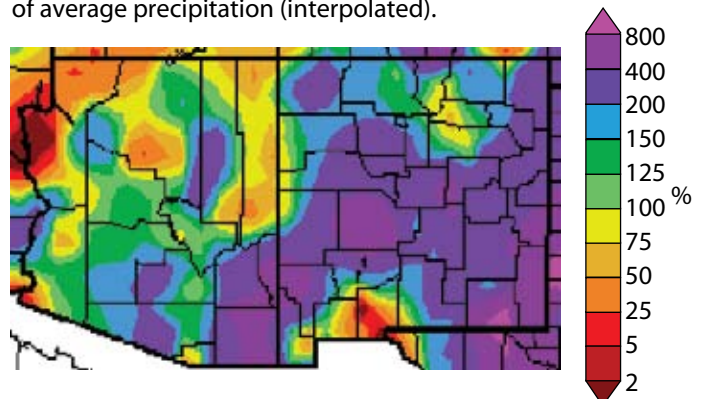
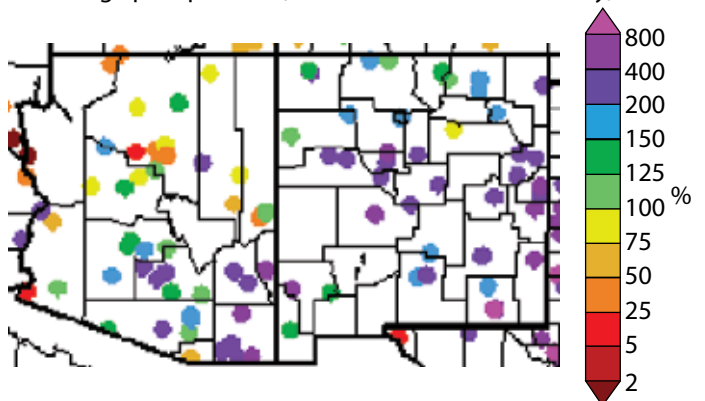


Figure 2d. Previous 30 days (March 20–April 18, 2007) percent of average precipitation (data collection locations only).



U.S. Drought Monitor

(released 4/19/07)

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

Drought conditions in the moderate drought category or worse have expanded over most of the West, with the exception of the Pacific Northwest and most of Colorado and New Mexico (Figure 3). In the Southwest, drought conditions are severe in Arizona and over the Four Corners region. Although most of New Mexico is drought free, the northwestern part of the state that borders Arizona has severe drought conditions. Conditions are abnormally dry along the Arizona-New Mexico border in the south.

In New Mexico, above-average summer precipitation in 2006 followed by above-average winter rain and snow has prevented the development of drought conditions. Storms have

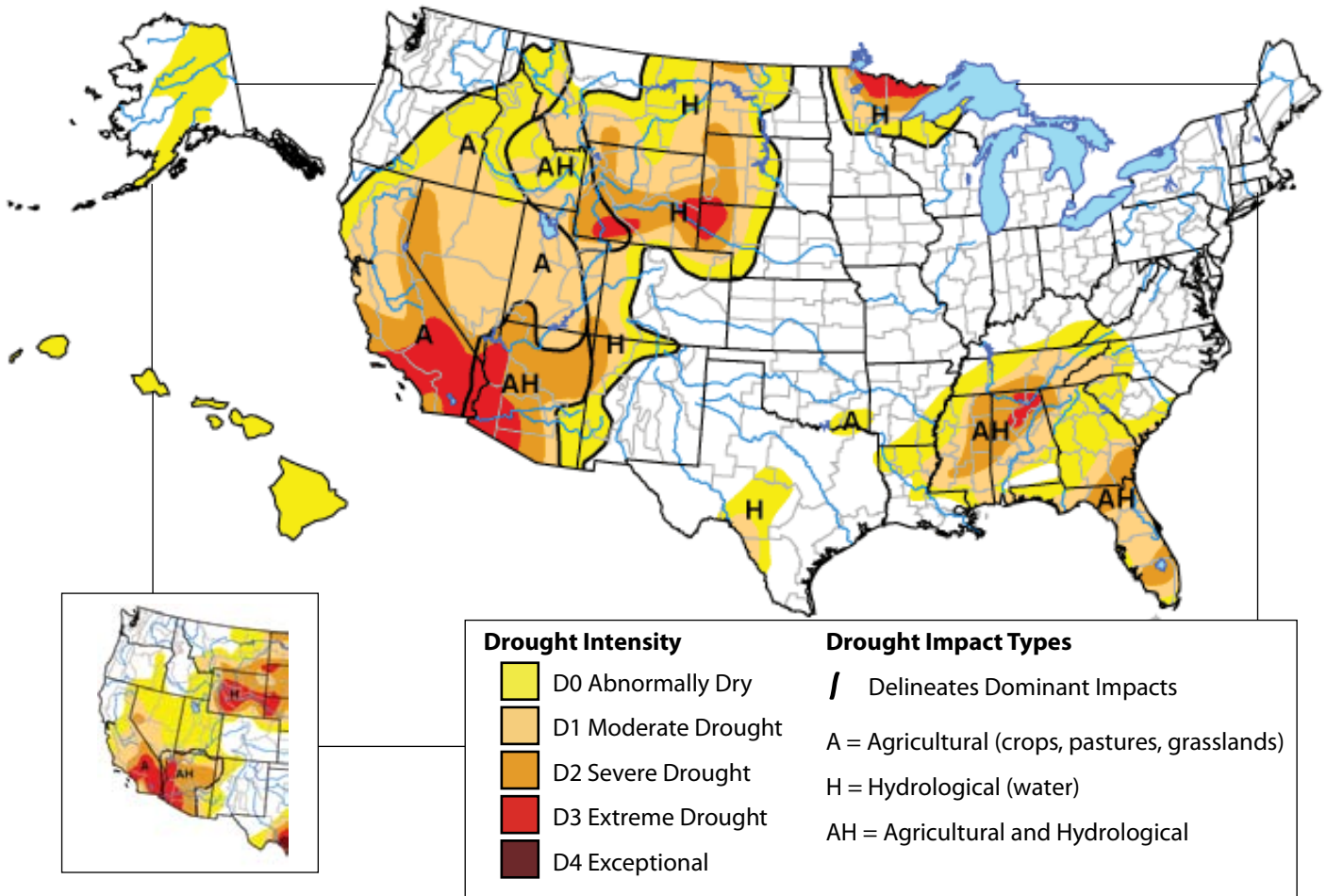
also continued to produce valley rain and mountain snow through spring. In Arizona, most winter storms produced less precipitation than New Mexico and generally fell only over the eastern part of the state. Winter storms have completely missed western Arizona for two consecutive winters, so drought conditions in the western part of the state have deteriorated. Record warmth in March in Arizona threatened to deteriorate drought conditions, but above-average precipitation, delaying the development of more severe drought.

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 David Miskus, JAWF/CPC/NOAA.

Figure 3. Drought Monitor released April 19, 2007 (full size) and March 15, 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

Record warmth and a rapid mountain snowmelt in mid-March threatened to deteriorate drought conditions in Arizona compared to conditions in February. However, some precipitation has improved drought conditions by one category in the lower Gila and Bill Williams watersheds (Figure 4a). March precipitation also improved the short-term drought conditions from moderate drought to abnormally dry over the Little Colorado and Salt River watersheds. The upper Gila and San Pedro watersheds as well as the Willcox Playa area have remained in the abnormally dry category, while the White-water Draw and Rio Yaqui watersheds remain drought free.

The long-term drought conditions have increased in severity from moderate to severe drought in the Santa Cruz watershed, and improved from moderate drought to abnormally dry in the Willcox Playa area since last month (Figure 4b). Precipitation received during March was substantial enough to improve conditions in the Willcox area, where between 150 and 200 percent of average precipitation was observed. However, only 5–75 percent of the average March precipitation fell over the Santa Cruz watershed. The long-term drought conditions for the rest of Arizona have remained unchanged since February.

Notes:

The Arizona drought status maps are produced monthly by the Arizona Drought Preparedness Plan Monitoring Technical Committee. The maps are based on expert assessment of variables including, but not limited to, precipitation, drought indices, reservoir levels, and streamflow.

Figure 4a shows short-term or meteorological drought conditions. Meteorological drought is defined usually on the basis of the degree of dryness (in comparison to some "normal" or average amount) over a relatively short duration (e.g., months). Figure 4b refers to long-term drought, sometimes known as hydrological drought. Hydrological drought is associated with the effects of relatively long periods of precipitation shortfall (e.g., many months to years) on water supplies (i.e., streamflow, reservoir and lake levels, and groundwater). These maps are delineated by river basins (wavy gray lines) and counties (straight black lines).

On the Web:

For the most current Arizona drought status maps, visit:
http://www.azwater.gov/dwr/Content/Hot_Topics/Agency-Wide/Drought_Planning/

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

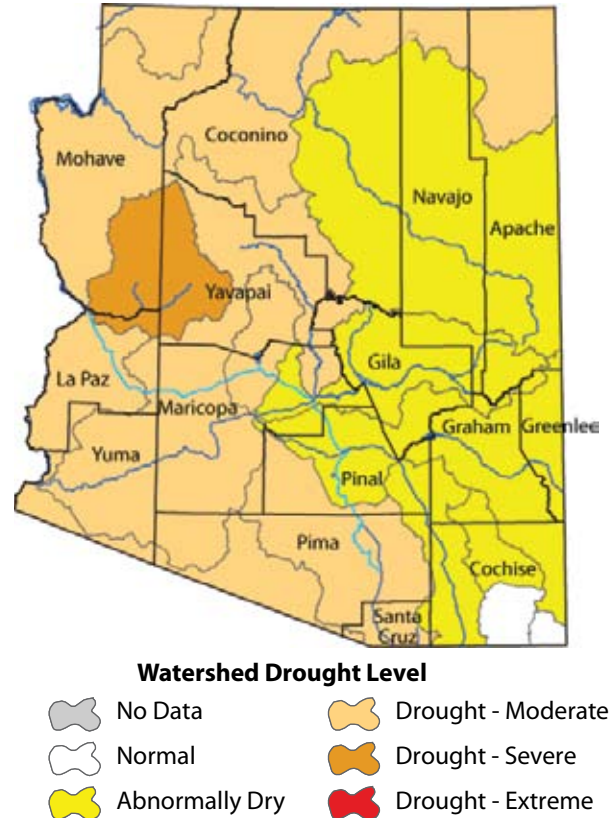
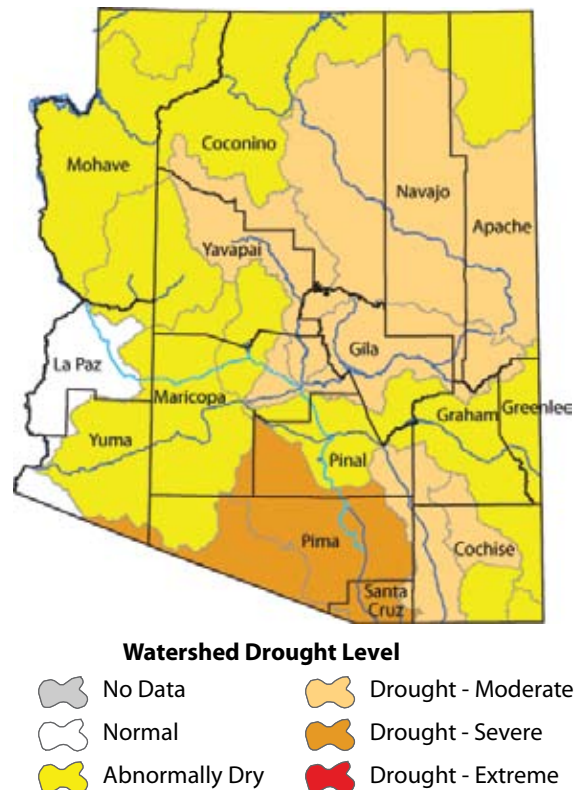


Figure 4b. Arizona long-term drought status for March 2007.

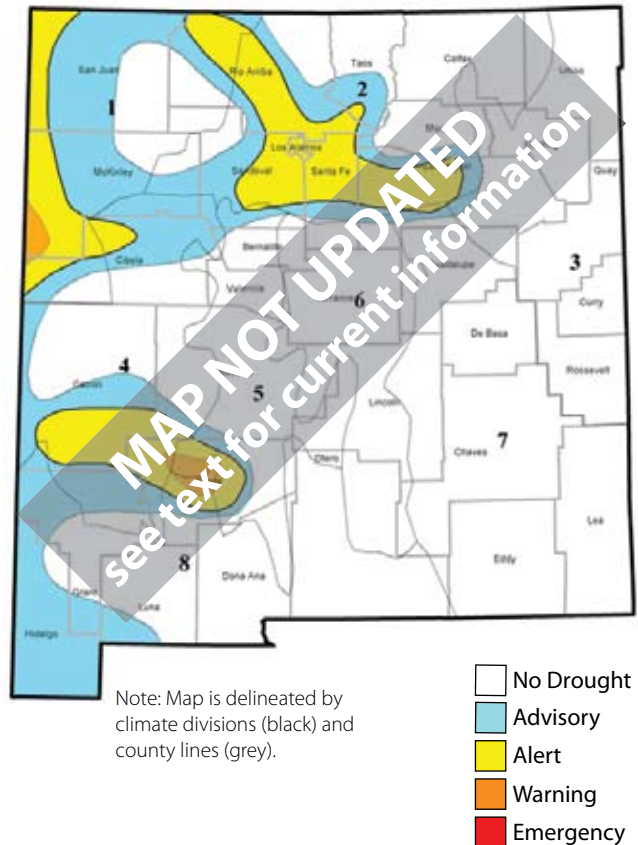


New Mexico Drought Status (through 4/30/07)

Source: New Mexico Natural Resources Conservation Service

Most of New Mexico remains in the drought free category based on above-average precipitation for the 2006 summer and the 2006–2007 winter season (Figure 5). New Mexico experienced a drying trend from mid-February through mid-March. However, in early April the state was again hit with a round of frontal storms bringing cool temperatures, valley rain, and mountain snow. As of March, parts of New Mexico remain in the advisory, mild, and moderate drought stages. Much of western New Mexico, along the border with Arizona, remains in the advisory drought status in the south and in the mild to moderate drought status in the north. Southern Catron County and central Sierra County in the south also remain in mild and moderate drought status, respectively. The northern mountains of New Mexico and parts of San Miguel, Santa Fe, Sandoval, Los Alamos, and Rio Arriba counties are at mild drought status, and observed precipitation is 70–90 percent of average for the 2007 water year up to April.

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



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 3/31/07)

Source: National Water and Climate Center

Storage in most Arizona reservoirs remained relatively unchanged from last month (Figure 6). Lake Mead experienced the largest change in volume (-358.0 thousand acre-feet), though this is only a 2.5 percent decrease. All other reservoirs, except for the San Carlos, have slightly increased storage relative to last month due to inflows from early spring snowmelt.

Recent warmer temperatures have affected snow runoff and inflow to reservoirs. Normally, snowpack above Lake Powell increases during March. This year, snowpack did not increase, partly due to above-average temperatures and below-average precipitation. Though unregulated inflow to Lake Powell was 120 percent of average in March, increased snowmelt and more precipitation falling as rain than snow mean there will be less inflow from April through July. Current projections from the U.S. Bureau of Reclamation predict inflow to Lake Powell will be 50 percent of average for the April-July period.

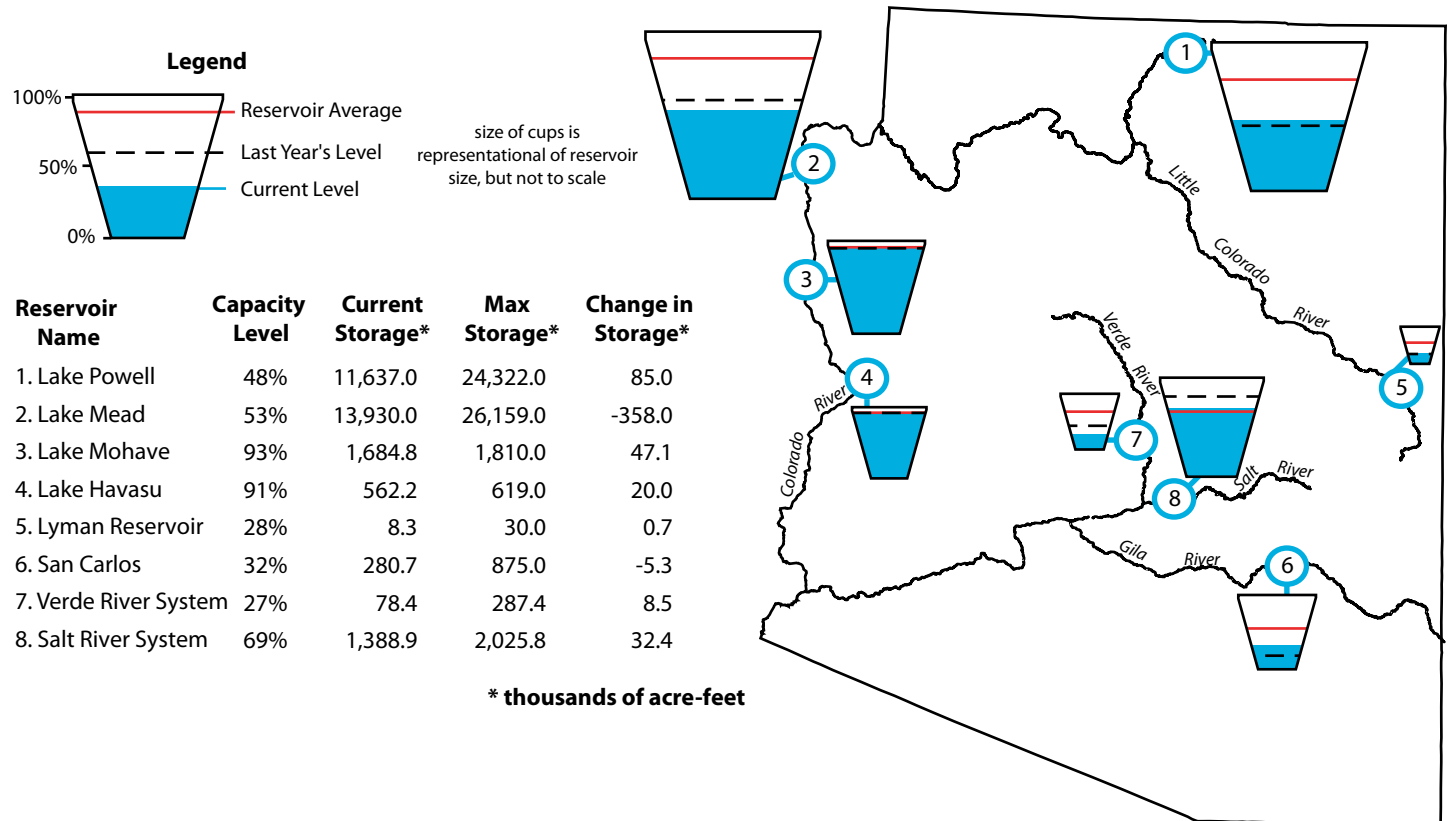
Notes:

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 March 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.



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 4/20/07)

Source: National Water and Climate Center

Storage increased slightly in most New Mexico reservoirs over the past month due to earlier-than-average spring snow runoff (Figure 7). Exceptions were Caballo Reservoir along the southern Rio Grande and Sumner Reservoir along the Pecos. Storage in Navajo Reservoir, the state's second largest, continues to be near capacity, while storage in the largest reservoir, Elephant Butte, increased slightly from last month.

Unregulated inflow into the Navajo Reservoir was 140 percent of average during March even though snowpack above the river was only 61 percent of average. Warmer temperatures and lack of precipitation contributed to the early snowpack melt. The high inflow in March will decrease from April through July. Current forecasts from the Bureau of Reclamation predict 59 percent of average inflow during this period.

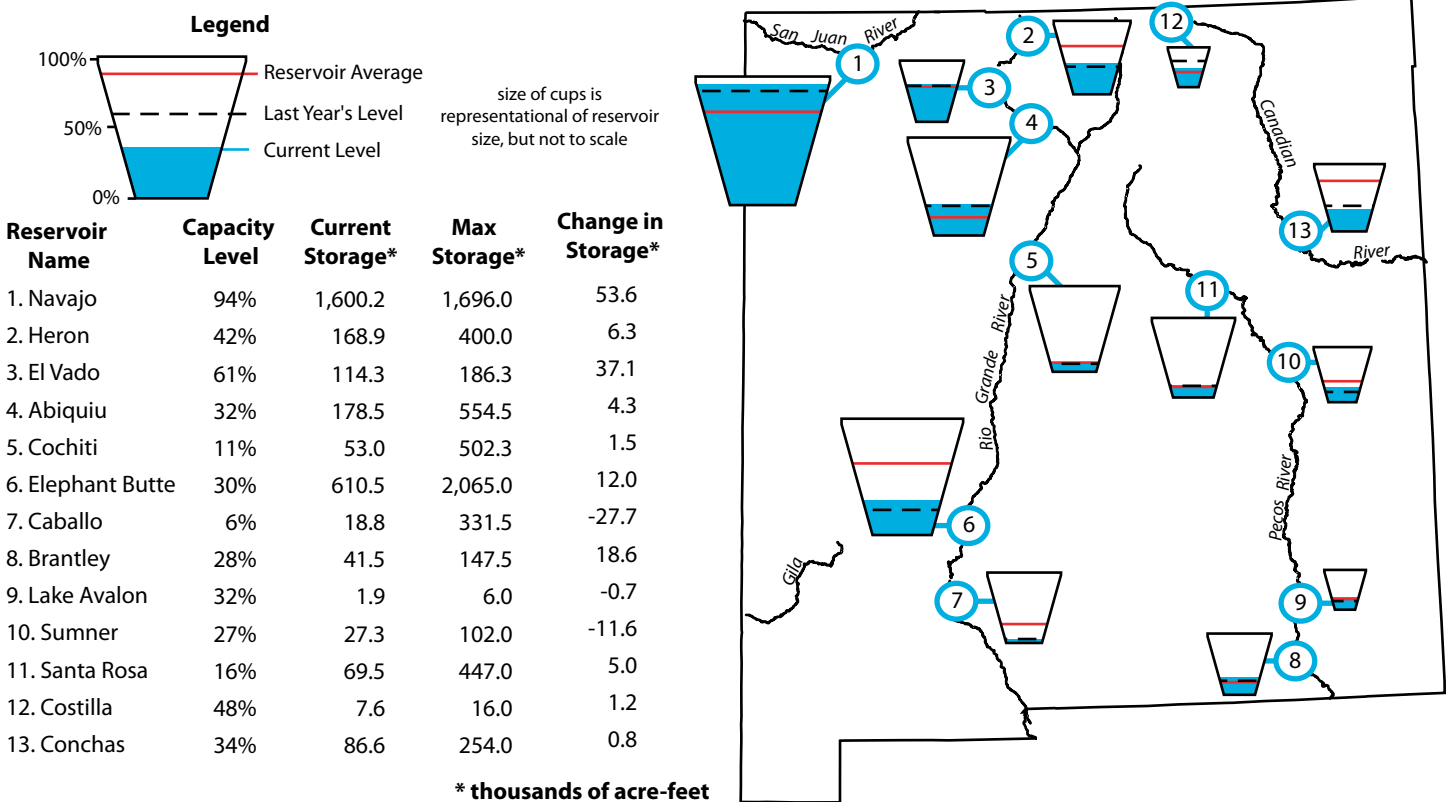
Notes:

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 March 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.



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

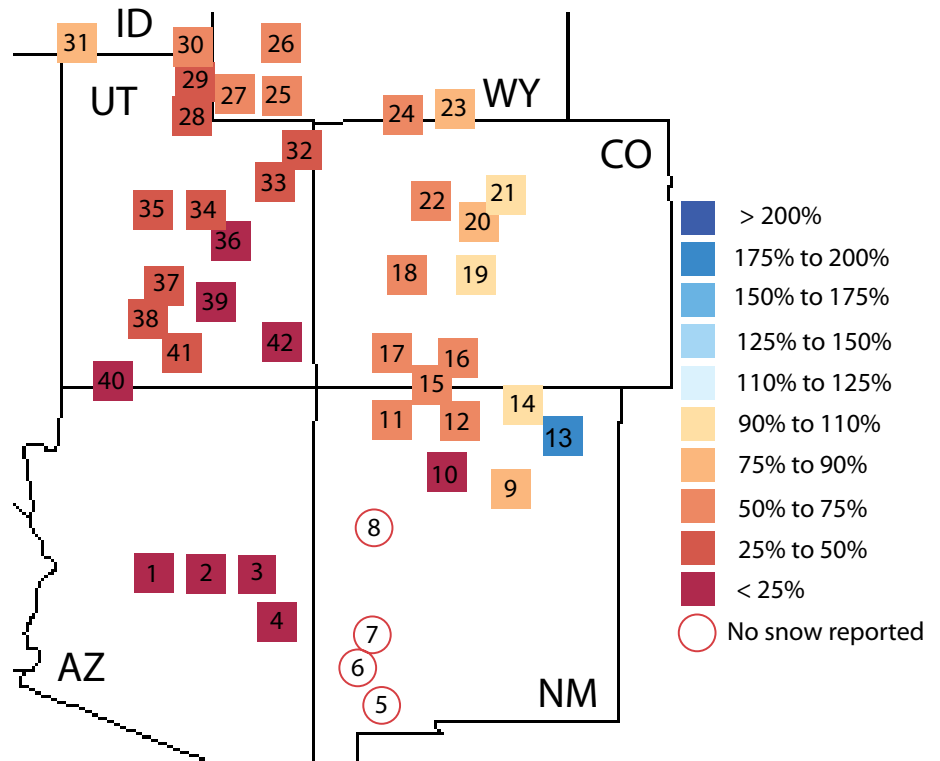
Southwest Snowpack

(updated 4/20/07)

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

Snowpack throughout the Southwest is below normal (Figure 8). In Arizona, reporting stations are all below 25 percent, and no snow is reported in stations in western New Mexico. Snowpack is in slightly better shape in northern New Mexico but still below average, except for the Sangre de Cristo Mountain Range Basin (90–110 percent of average) and the Cimarron River Basin (175–200 percent of average). Recent above-average temperatures have contributed to early snowpack melting and precipitation falling as rain rather than snow. As a result, inflow to reservoirs was above-average during March due to early melting, but April to July streamflow and reservoir inflow are predicted to be below normal. Snowpack is also below average throughout Utah, Colorado, Idaho, and Wyoming.

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

Colorado Basins

- 11 San Miguel, Dolores, Animas, and San Juan River Basins
- 12 Rio Chama River Basin
- 13 Cimarron River Basin
- 14 Sangre de Cristo Mountain Range Basin
- 15 San Juan River Headwaters

Notes:

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

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

On the Web:

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

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

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



Southwest Fire Summary (updated 4/20/07)

Source: Southwest Coordination Center

As of April 9, 2007, 402 fires have started in Arizona and New Mexico, burning a combined 25,451 acres (Figure 9a). The majority of these fires have been human caused. Arizona and New Mexico report zero fires exceeding 100 acres burning as of April 20, 2007 (Figures 9b–9c). These numbers do not include prescribed fires, which are set to prevent larger fires or to promote ecosystem health, or wildland fire use, in which natural fires are allowed to burn while they pose no threats to human life or property.

At the end of April last year, more than double the amount of fires as this year and 31 large fires (greater than 100 acres) had burned in the region. Increased winter and spring precipitation relative to last year has helped suppress early season fire activity so far this year.

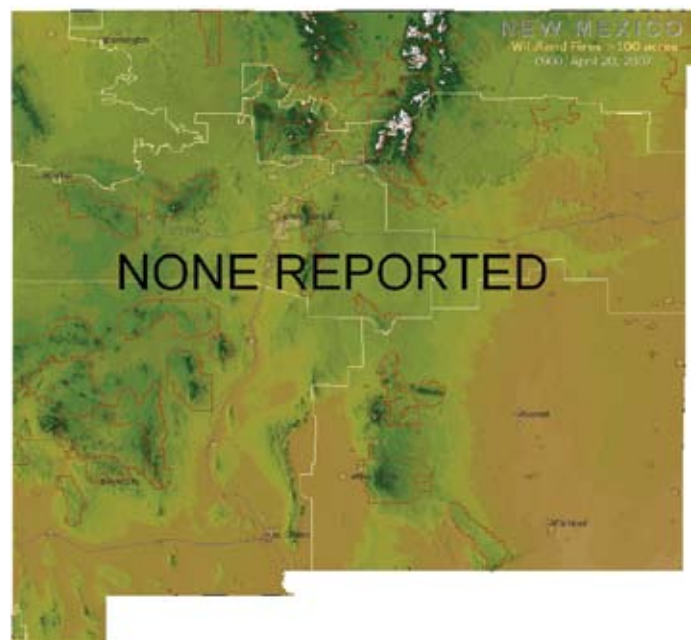
Figure 9a. Year-to-date fire information for Arizona and New Mexico as of April 9, 2007.

State	Human Caused Fires	Human caused acres	Lightning caused fires	Lightning caused acres	Total Fires	Total Acres
AZ	200	4,924	3	72	203	4,996
NM	183	17,982	16	2,473	199	20,455
Total	383	22,906	19	2,545	402	25,451

Figure 9b. Arizona large fire incidents as of April 20, 2007.



Figure 9c. New Mexico large fire incidents as of April 20, 2007.



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



Temperature Outlook (May–October 2007)

Source: NOAA Climate Prediction Center (CPC)

Temperatures are forecast to be warmer than average in the Southwest through October 2007, according to the NOAA-CPC. Through late spring and early summer, highest probabilities of above-average temperatures in the nation (greater than 60 percent) are centered over Arizona (Figure 10a). As the forecasts progress, areas with the highest likelihoods for warmer temperatures shift north and west to include most of the Great Basin region (Figures 10b–10d). By summer, above-average temperatures are forecast for much of the country, reflecting recent observed warming trends.

Warmer temperatures in the Southwest could have significant impacts this summer. Existing drought conditions could worsen as higher temperatures increase evapotranspiration (water loss to the atmosphere through plant leaves) rates and energy consumption related to increased cooling demands.

Figure 10a. Long-lead national temperature forecast for May–July 2007.

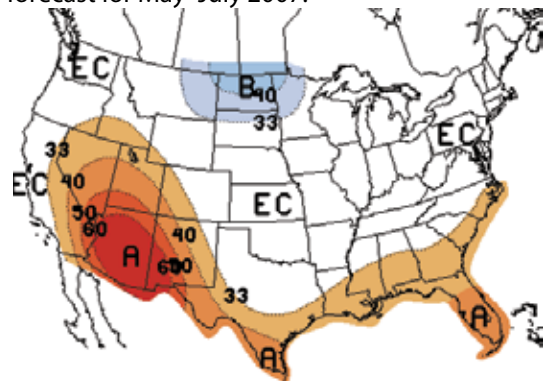


Figure 10c. Long-lead national temperature forecast for July–September 2007.

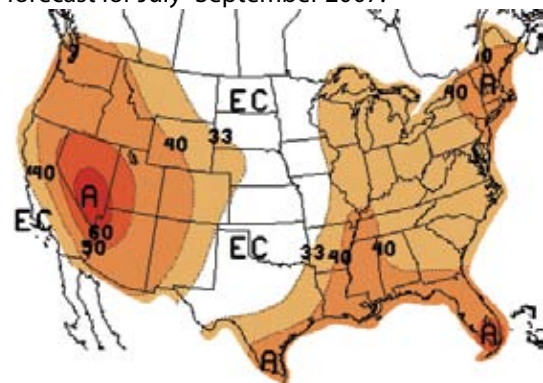


Figure 10b. Long-lead national temperature forecast for June–August 2007.

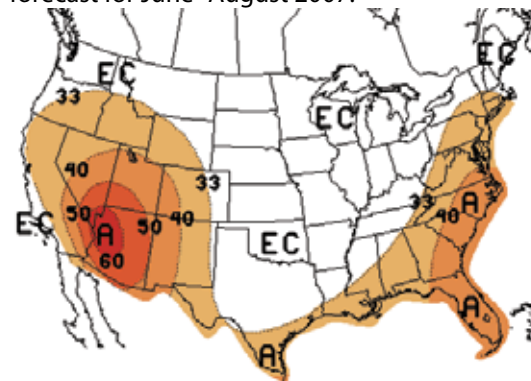
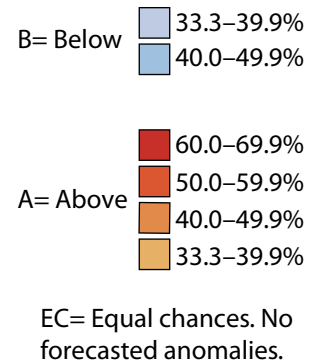
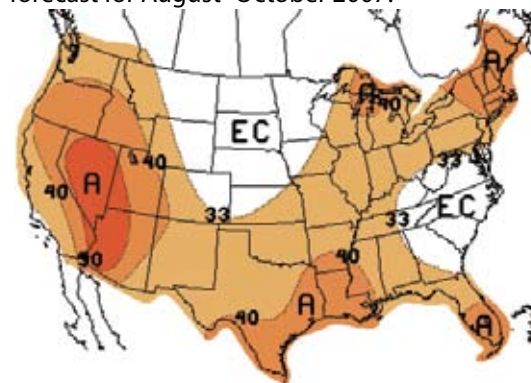


Figure 10d. Long-lead national temperature forecast for August–October 2007.



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.

On the Web:

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

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



Precipitation Outlook (May–October 2007)

Source: NOAA Climate Prediction Center (CPC)

Forecasters from the NOAA-CPC predict equal chances of below-average, average, or above-average precipitation for much of the United States through October 2007 (Figures 11a–11d). ENSO conditions in the tropical Pacific Ocean can have a large influence on North American precipitation and many forecasts are based on ENSO conditions. Spring season precipitation is not strongly connected to ENSO, making seasonal precipitation forecasts difficult.

Even average precipitation this summer would be welcome in the Southwest, especially in drought-stricken portions of Arizona. Though summer precipitation is not as important to replenishing water resources as winter precipitation, it could alleviate short-term drought conditions and improve vegetation and wildlife health. Heavy summer rainfall also comes with an increased risk of destructive flooding.

Notes:

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

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

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

Equal Chances (EC) indicates areas where the reliability (i.e., ‘skill’) of the forecast is poor; areas labeled EC suggest an equal likelihood of above-average, average, and below-average conditions, as a “default option” when forecast skill is poor.

Figure 11a. Long-lead national precipitation forecast for May–July 2007.

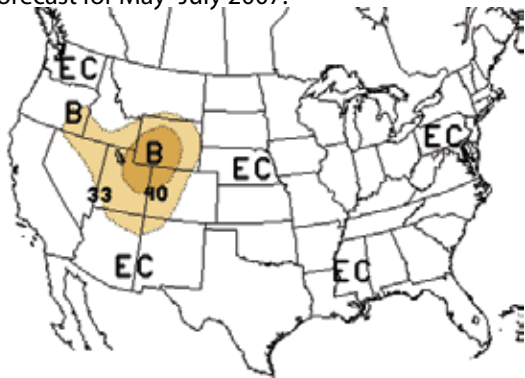


Figure 11b. Long-lead national precipitation forecast for June–August 2007.

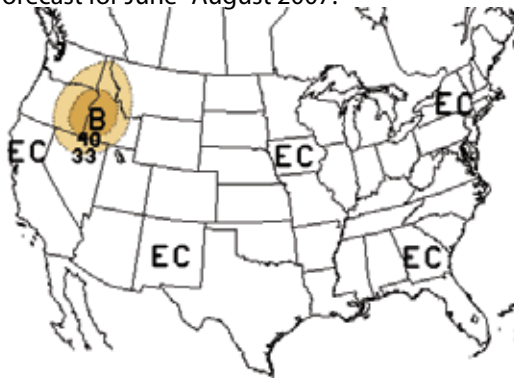


Figure 11c. Long-lead national precipitation forecast for July–September 2007.

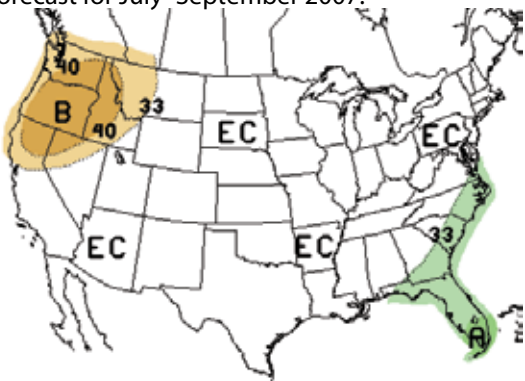
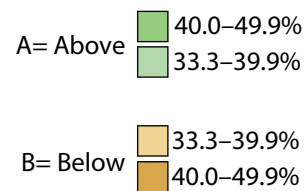
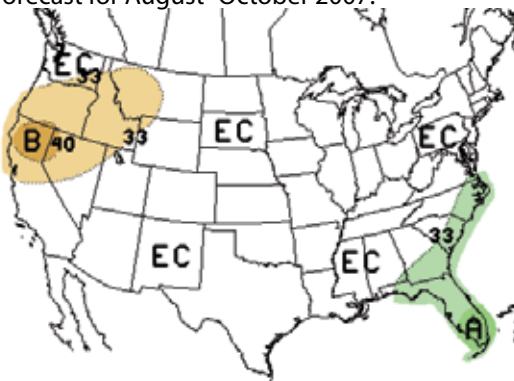


Figure 11d. Long-lead national precipitation forecast for August–October 2007.



EC= Equal chances. No forecasted anomalies.

On the Web:

For more information on CPC forecasts, visit:

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

For IRI forecasts, visit:

http://iri.columbia.edu/climate/forecast/net_asmt/



Seasonal Drought Outlook (through July 2007)

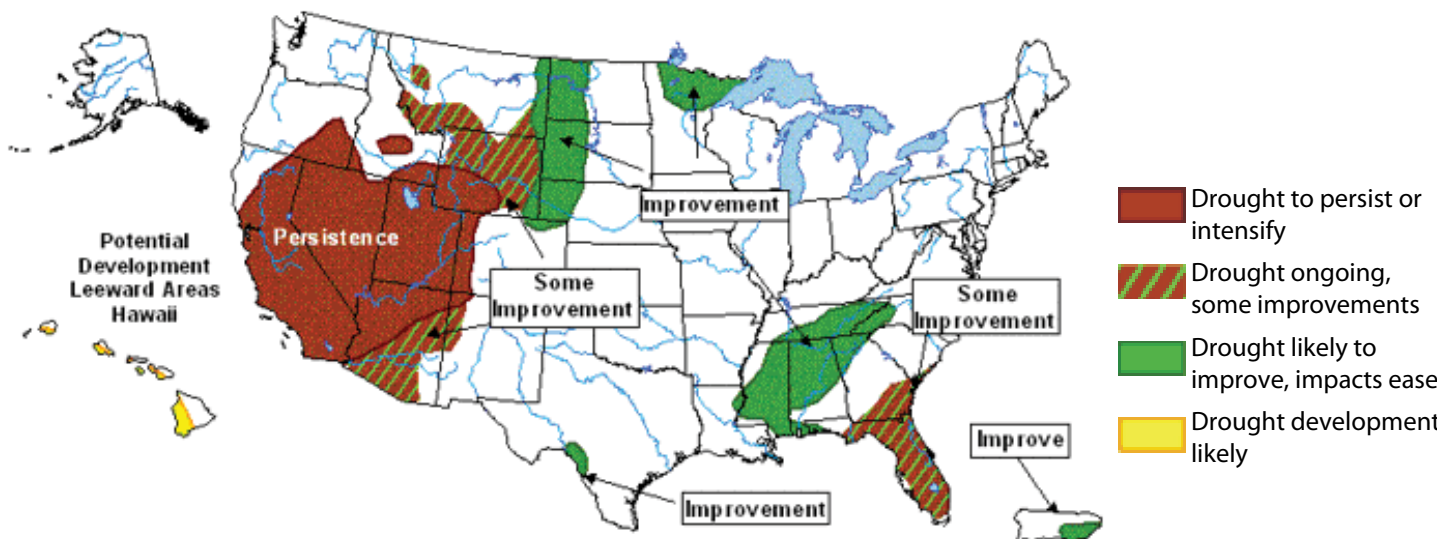
Source: NOAA Climate Prediction Center (CPC)

Drought conditions are expected to persist or intensify in northwestern Arizona but could show some improvement in southeastern Arizona, according to the NOAA-CPC seasonal drought outlook (Figure 12). Through July 2007, temperatures are expected to be warmer than average in most of the Southwest and this could exacerbate the drought in some areas. Higher temperatures could mean more water consumption as well as increased evapotranspiration rates. Precipitation forecasts call for equal chances of below-average, average, or above-average rainfall. Above-average or even average rainfall would mean more moisture than in previous years and could mean a slight improvement in short-term drought conditions. Elsewhere, drought conditions are expected to improve somewhat in Florida and Wyoming and show definite improvement in much of the South and upper Midwest.

Notes:

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

Figure 12. Seasonal drought outlook through July 2007 (release date April 19, 2007).



On the Web:

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



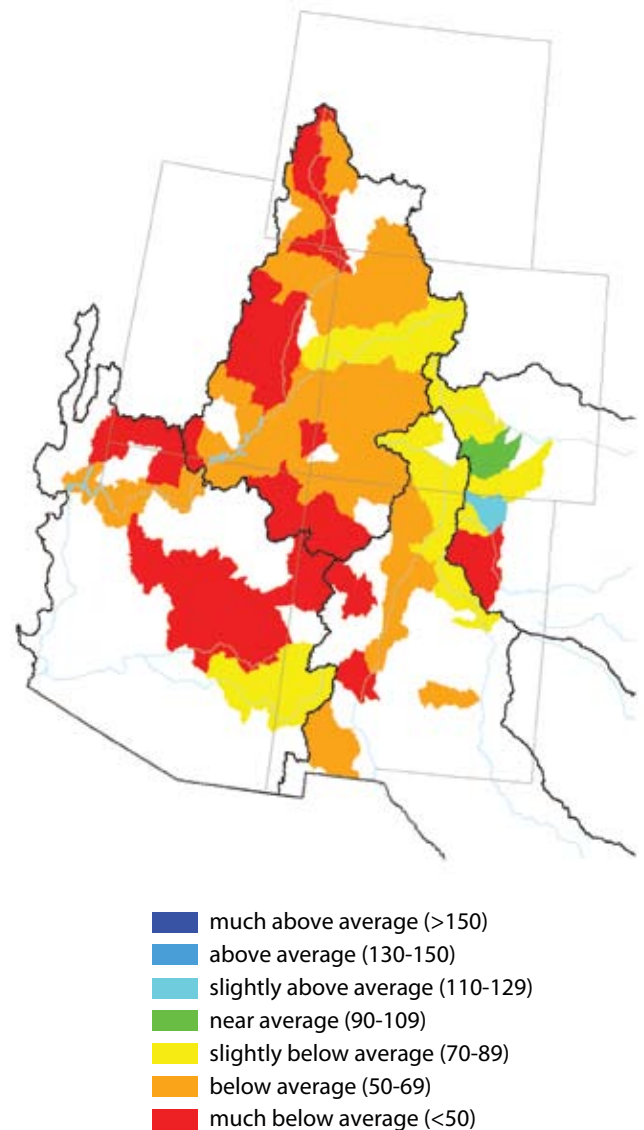
Streamflow Forecast (for spring and summer)

Source: National Water and Climate Center

Streamflows are forecast to be below average for much of the West (Figure 13). Below-average snowpack and precipitation last winter in most areas means less water in streams this spring and summer. Flow along the Colorado is forecast to be 50–69 percent of average, while the Little Colorado is expected to be less than 50 percent of average. In New Mexico, the Rio Grande is forecast to be 50–69 percent of average, while the Upper Canadian will have slightly above-average flows (110–129 percent of average).

Low streamflows will have many impacts in the Southwest. The health of some riparian areas could be compromised and inflow into reservoirs will be reduced (see Figures 6–7). Low streamflows could also exacerbate drought conditions and negatively affect tourism in some areas.

Figure 13. Spring and summer streamflow forecast as of April 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.

On the Web:

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

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

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



Wildland Fire Outlook

Sources: National Interagency Coordination Center, Southwest Coordination Center

Wildland fire potential is forecast to be above normal in western Arizona, where long-term precipitation has been below normal (Figure 14a). In eastern New Mexico, above-average precipitation last summer and this winter have contributed to a below-normal fire potential forecast. Conditions are expected to be normal for the rest of the Southwest. For much of the remainder of the United States, conditions are expected to be normal. Exceptions include above-average fire potential in the South and in the upper half of Minnesota and the northern tip of Wisconsin.

Current fine fuels are relatively green due to recent precipitation events, and new growth is normal to above normal (Figure 14b). These fine fuels have the potential to increase fire potential later in the spring if they dry significantly, while other live fuels have near-average moisture levels.

Figure 14a. National wildland fire potential for fires greater than 100 acres (valid April 1–30, 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	96
Juniper	76
Piñon	88
Ponderosa Pine	88
Sagebrush	122
1000-hour dead fuel moisture	6–21
Average 1000-hour fuel moisture for this time of year	12–20

Notes:

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

The Southwest Area Wildland Fire Operations produces monthly fuel conditions and outlooks. Fuels are any live or dead vegetation that are capable of burning during a fire. Fuels are assigned rates for the length of time necessary to dry. Small, thin vegetation, such as grasses and weeds, are 1-hour and 10-hour fuels, while 1000-hour fuels are large-diameter trees. The top portion of Figure 14b indicates the current condition and amount of growth of fine (small) fuels. The lower section of the figure shows the moisture level of various live fuels as percent of average conditions.

On the Web:

National Wildland Fire Outlook web page:
<http://www.nifc.gov/news/nicc.html>

Southwest Area Wildland Fire Operations (SWCC) web page:
<http://www.fs.fed.us/r3/fire/>



El Niño Status and Forecast

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

Current ENSO conditions are neutral, but current sea surface temperatures (SSTs) are below average in the eastern Pacific and along the coast of Peru, indicating increased chances for a return to La Niña conditions by mid-2007. Probabilistic models show a 50 percent chance of La Niña conditions developing by late spring and early summer. This is slightly greater than the odds of ENSO-neutral conditions persisting (Figure 15b). Southern Oscillation Index (SOI) values also show borderline neutral conditions (Figure 15a).

In general, La Niña conditions favor drier-than-average winter conditions in the Southwest as storm tracks are pushed northwards. ENSO influences on summer precipitation are less clear.

Notes:

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

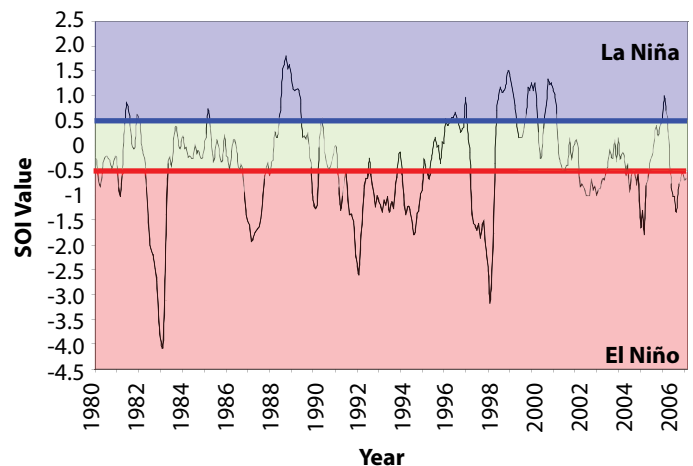
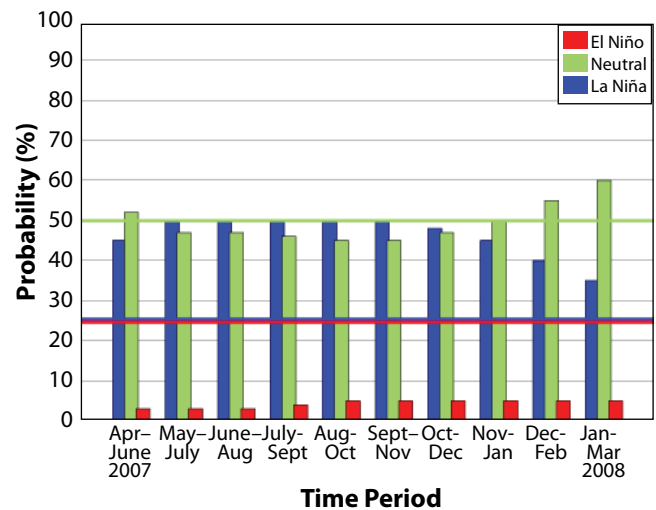


Figure 15b. IRI probabilistic ENSO forecast for El Niño 3.4 monitoring region (released April, 20 2007). Colored lines represent average historical probability of El Niño, La Niña, and neutral.



Temperature Verification

(January–March 2007)

Source: NOAA Climate Prediction Center (CPC)

The NOAA-CPC long-lead national forecast for January–March 2007 temperatures predicted the probability for above-average temperatures across the entire northern tier of the U.S. (Figure 16a). The southern tier of states, from North Carolina to eastern New Mexico, had a higher probability towards below-average temperatures associated with the continuance of El Niño conditions in the tropical Pacific. There was general agreement with the forecast from the western Great Lakes region through the northern Great Plains, where temperatures were 0–6 degrees F above average (Figure 16b). However, average temperatures from the eastern Great Lakes to New England were near average. In New England, record warm temperatures in early January were followed by below-average temperatures in February and average temperatures in March. Temperatures 2–4 degrees F above average from the Ohio-Mississippi river convergence to Oklahoma in the west and eastward to North Carolina favored the forecast for above-average temperatures. The forecast was on target in the West with above-average temperatures observed in the Northwest and northern Rockies. In the Southwest equal changes for above- or below-average temperatures were forecasted, and the observed temperatures were within 2 degrees F of average. An exception was observed in eastern Colorado and eastern New Mexico, where temperatures were 2–6 degrees below average for most of the period.

Notes:

Figure 16a shows the NOAA Climate Prediction Center (CPC) temperature outlook for the months January–March 2007. This forecast was made in December 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 January–March 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 January–March 2007 (issued December 2006).

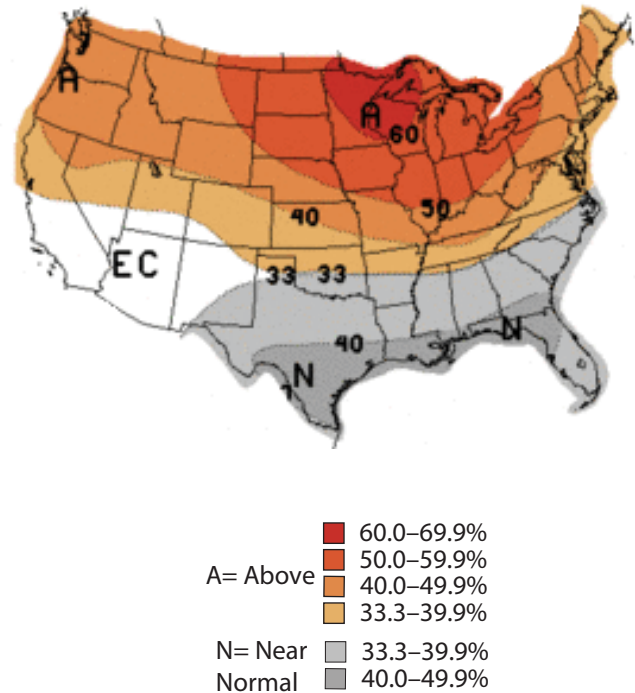
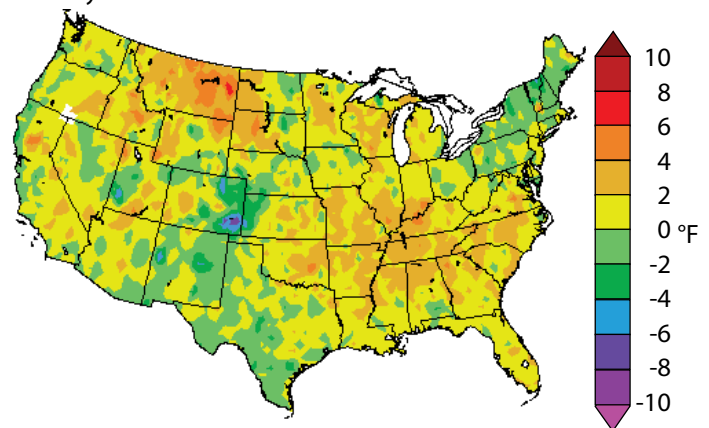


Figure 16b. Average temperature departure (in degrees F) for January–March 2007.



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

(January–March 2007)

Source: NOAA Climate Prediction Center (CPC)

The NOAA-CPC long-lead national precipitation forecast for January–March 2007 predicted increased probabilities for above-average precipitation across the southern tier of the U.S. in association with El Niño conditions in the tropical Pacific (Figure 17a). Greater probabilities for above-average precipitation were predicted specifically for southern California, southern New Mexico, west Texas, and the Florida peninsula. The prediction for greater chances for above-average precipitation was a bulls-eye for southern New Mexico and western Texas, where observed precipitation was 125–800 percent of average (Figure 17b). However, the forecast did not match the observed conditions in southern California, Arizona, and Florida, where precipitation was generally only 5–75 percent of average. During this past winter season, there was a dominant trough over the western U.S. with the jet and storm track entering through New Mexico from the south, which also brought additional moisture to the southern Great Plains. The Southwest was within the forecast for greater chances of above-average precipitation, but these conditions only were observed in New Mexico; most of the state received 100–400 percent of its average precipitation. Many storms passed to the north of Arizona, which resulted in the state only receiving 5–100 percent of average precipitation for January–March.

Notes:

Figure 17a shows the NOAA Climate Prediction Center (CPC) precipitation outlook for the months January–March 2007. This forecast was made in December 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 17b shows the observed percent of average precipitation for January–March 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 January–March 2007 (issued December 2006).

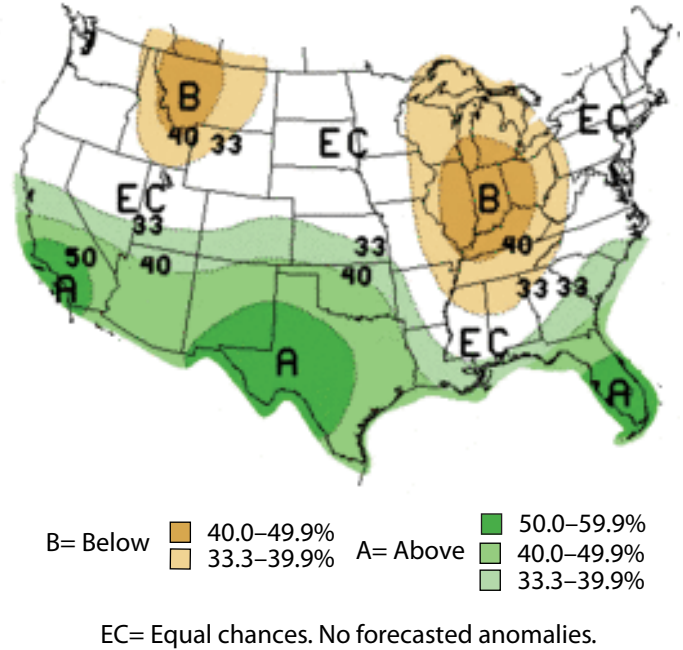
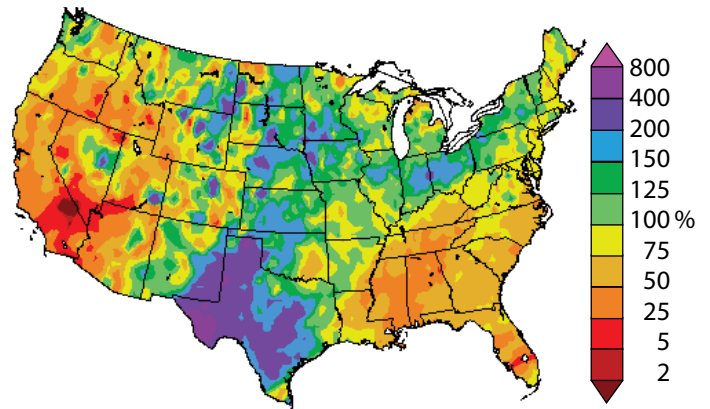


Figure 17b. Percent of average precipitation observed from January–March 2007.



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

