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Southwest Climate Outlook

THE UNIVERSITY OF ARIZONA.
Arizona's First University.

Source: GiGi Owen

Photo Description: This photo taken in June 2008, shows a pecan orchard in New Mexico being flood irrigated.

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In this issue...

January Climate Summary

Drought – A swath of abnormally dry conditions persists in the north and central parts of Arizona, while drought conditions are no longer present in west-central parts of the state. Most of eastern New Mexico is now classified as abnormally dry.

Temperature – Western Arizona has been mostly 4–6 degrees F colder than average, while eastern New Mexico has been mostly 2–4 degrees F warmer than average.

Precipitation – A series of winter storms moved across Arizona and northwestern New Mexico in the past 30 days. While most of Arizona received 100–400 percent of average precipitation, most of New Mexico received less than 50 percent of average.

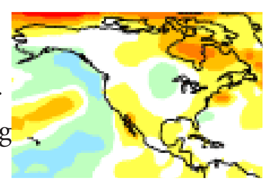
ENSO – Sea surface temperatures cooled across much of the equatorial Pacific Ocean through December and early January, causing NOAA-CPC to declare a La Niña event.

Snow – Winter storms in December covered the higher elevations in many watersheds in Arizona and New Mexico with snow. On January 1, major river basins in Arizona had snow water equivalent (SWE) ranging between 131 and 334 percent of average; northern New Mexico had values of 100 to 175 percent of average.

Climate Forecasts – Forecasts show increased chances of above-average temperatures for much of the Southwest through June, and slightly increased chances of below-average precipitation for Arizona and New Mexico through May.

The Bottom Line – Recent winter storms should improve short-term drought conditions in Arizona and will be reflected in the February Southwest Climate Outlook. The recent development of a La Niña event suggests the total winter precipitation will be below average. These conditions likely contributed to near-average streamflow forecasts for the spring-summer despite the above-average early-season snowfall accumulations.

Last year one of the warmest since 1880



On December 16, NASA's Goddard Institute for Space Studies (GISS), the National Oceanic and Atmospheric Administration, and Britain's Hadley Center released surface air temperature summaries for the meteorological year beginning December 1, 2007, and ending November 31, 2008. According to each of these records, which are based on different networks of measuring instruments, the average global temperature for this meteorological year was about 0.75 degrees F warmer than the 1951–1980 average. GISS temperature analysis shows that the average surface air temperatures in the majority of Arizona and New Mexico were between 0.0 and 0.2 degrees F above average.

According to the GISS temperature analysis, this past meteorological year is between the seventh and twelfth warmest since widespread record-keeping began in 1880—the range arises from uncertainty in the measurements. Although, this year's average global temperature was the coolest since 2000, influenced by the La Niña.

For more information: http://data.giss.nasa.gov/...

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Cattle and climate: Ranching in the arid Southwest

By Zack Guido

Knee-high Lehman lovegrasses and blue gramma grasses, cured brown by the dry weather, bowed in the wind on flanks of the Chiricahua Mountains in southeast Arizona. Cows grazed near a windmill, the ears and back of a loping coyote bobbed in and out of view in the distance, and a wind vane pointed west. Welcome to Jim Riggs' Crossed J ranch, 10,000 acres of shrub-covered hills and grassy plains that have fattened herds in wet years and thinned them during droughts since the ranching boom of the late 1800s.

"When we have good grass cover like we do this year, it really protects the pastures and cows," Riggs said, spreading his hand over the tops of grasses. "When the grasses are stripped, the soils don't hold the moisture well, and the grasses don't grow well."

Riggs' knowledge about his ranch is time tested. He draws his experience from a ranching history that has spanned four generations—back to 1879—and weathered hard times, including numerous droughts that bankrupted many other ranchers.

In the early ranching days in Arizona, ranchers paid little attention to the number of cows munching the grass and consequently grazed the landscape to a nub, causing widespread soil erosion. The degraded soils combined with a scarcity of ungrazed land to make the cattle industry extremely vulnerable to drought; when dry periods limited grass growth, cattle numbers plummeted.

Climate has always shaped ranching in Arizona, mostly acting as a limit on the number of livestock that the arid landscape can support. This will continue—natural variability will cause periodic drought—but the expectation that a warming world will increasingly parch the Southwest has caught the attention of ranchers.

Figure 1: Jim Riggs (middle) walks in knee-high grasses with UA scientists Mike Crimmins (right) and Wim van Leeuwen on his ranch in the foothills of the Chiricahua Mountains in southeast Arizona.

Now, ranchers like Riggs and Dennis Moroney, owner of the 30,000-acre 47 Ranch near Tombstone, Arizona, are arming themselves with knowledge of past ranching obstacles and a keen eye toward future climate challenges, and are tuning their ranch operations to the environment.

"We do live in an arid region," Moroney said. "But the landscape has abundance and is extremely effective at producing food as long as we approach it on the right scale."

A Brief History of Ranching in Arizona

Stock raising in Arizona began around 1690. Spanish ranchers first settled in the Huachuca Mountains in the headwaters of the Santa Cruz River around the same time that Jesuit missionaries bestowed livestock to O'odham Indians, who agreed to live in mission communities, according to *Arizona: A History*, a book by Thomas Sheridan, professor of Anthropology at The University of Arizona. Ranching began in earnest in the 1730s with a revival of the Jesuit missions and a mining boom. As the Santa Cruz Valley population grew, so did the demand for beef.

For many years, the Apache Indians prevented ranchers from settling outside the Santa Cruz Valley. By the end of the American Civil War in 1865, conditions became favorable for large-scale ranching in Arizona. The Civil War had disrupted the cattle industry, leaving five million longhorns to overgraze the pastures of Texas. With grass little more than stubble, Texas ranchers moved north as well as west into Arizona. Cattle numbers in Arizona quickly grew as Texas cows populated the area. In addition, the windmill, which was used to pump groundwater into storage ponds, and two transcontinental railroads across Arizona enabled large capital investments by businessmen seeing profit in the growing beef markets.

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Cattle, continued

By the early 1890s, Arizona cattle numbered about 1.5 million head, and more than a million sheep also roamed the landscape. Just two decades earlier, in 1871, cattle numbers hovered around only 40,000.

In a short time, the wild Arizona country was converted into a gigantic livestock ranch. Sheridan noted in his book a rancher's reflections at the time: "We fondly imagined that these wonderful ranges would last forever and couldn't be overstocked." This perception, aided in part by favorable climate conditions that enabled healthy and bountiful forage to grow, led to a tragedy of the commons. In 20 years, ranchers allowed cattle to overgraze the open ranges, destroying the shared pasturelands.

By the mid-1880s, Sheridan wrote, a few wary stockmen concluded that ranges along the San Pedro River were "already stocked to their full capacity." A year later, the Tombstone Stock Growers Association recognized that "a crisis is fast approaching" and called for the end of importing more cattle to the area.

Although 1891 was Arizona's biggest calf crop to date, less than one-half of the average rainfall soaked the ground. When new grasses didn't grow as they had before and the cows had mowed all the old grasses, ranchers realized there was a limit to the number of cattle the land could support.

Yet very few ranchers reduced their stock. Most of them undoubtedly expected rain and grasses to return the coming year. But the summer and winter of 1892 were dry, as was the following spring. In the early summer of 1893, the bone-dry creeks and springs were evidence of the first recorded drought to have major impacts on the cattle industry in Arizona. The southern Arizona cattle population was decimated; 50 to 75 percent of all livestock perished.

Figure 2: UA scientist Mike Crimmins peers into a rain gauge, while colleague Wim van Leeuwen adds a larger memory card to the self-timed, digital camera.

Ranchers raced most of the cattle that did not die to market, swamping the supply and driving down prices. This, combined with a national economic depression, gave ranchers little choice but to sell cattle at rock bottom prices. Sheridan wrote that "when the dry years struck and the national market price for cattle collapsed, many of the ranchers left. Arizona's natural bounty had been exhausted. From now on, successful stock raisers had to be stewards, not scourges."

Lessons Learned

During the cattle boom in the late 1800s, ranchers stocked their lands with as many as one cow per five acres, and environmental degradation ensued. Now, the rule of thumb for stocking rates for Moroney's ranch near Tombstone is about one full-grown cow per 65 acres. Moroney, however, stocks more conservatively at about one cow per 75 acres.

"We are in the restoration phase of a degraded landscape," he said above the bleating of two orphaned goats that he was bottle-feeding. "Much of the Southwest landscape has a history of drought and mismanagement. Ranchers before us didn't mean to do harm, they just didn't know as much as we do now."

Riggs also stocks his ranch conservatively. The rule of thumb for his ranch near the Chiricahuas is slightly different. He allows one cow-calf combination for every 40 acres.

Both Riggs' and Moroney's livestock consume only about 60 percent of the forage, giving their ranches a large margin of error in case scant summer rains do not sprout ample grasses, or in case the price of beef plummets.

"In drought years, the landscape doesn't produce as much forage," Moroney said. "The natural reaction by managers is to pull their animals off the ranch. But when hundreds of ranches go to the market at the same time, the laws of supply and demand lower the price."

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Cattle, continued

With a reserve of forage, Moroney and Riggs can leave their cattle on the landscape, waiting for the price to rebound.

Learning Lessons

Riggs held up a long stalk of gramma grass, its leaf hooked at the stock end in the shape of a crescent moon. Behind him, two University of Arizona researchers repaired a weather station and added a larger memory card to an automatic camera. To the untrained eye, the thin grasses covering the landscape all look identical. But Riggs pointed out subtle differences in a few of the roughly 30 species that dominate the grass population on his ranch.

"The cows really love the blue gramma grasses. Its palatability is better than Lehman lovegrass and it doesn't lose as much nutrition as the Lehmans when it cures," he said. "But Lehmans are much more productive. We've had seasons when Lehmans have saved us."

Grass is just as important to Riggs as his cattle. Today, as in the past, ranching is almost entirely dependent on the natural vegetation of the low and high desert ecosystems, with very few ranchers relying on irrigated pasture. When the grasses are healthy, the cattle are healthy. That is why Riggs is participating with the UA scientists in a pilot project to monitor his rangeland in an effort to collect information that will help reduce his ranch's vulnerability to weather and climate change.

"We go to workshops all the time," Riggs said, referring to the community of ranchers. "We read. We try to stay up to date. There is an art to range management and rangeland monitoring is extremely important."

The UA scientists, Mike Crimmins, a climate science extension specialist and CLIMAS research affiliate, and Wim van Leeuwen of the Arizona Remote Sensing Center, collaborate with Riggs to understand how pasturelands respond to climate. While Crimmins tinkered with the rain gauge on the weather station, van Leeuwen downloaded three months' worth of photography from the mounted camera that shoots photographs of a swath of pastureland every hour.

The weather station, which also measures moisture in the soil, hopefully holds clues to how the timing of precipitation affects grass growth and how soils moderate climate extremes. Crimmins' working hypothesis is that grasses grown on finer soils are more resilient to drought because those soils hold moisture longer. Van Leeuwen compares the photographs to images taken by satellites that report the "greenness" of the landscape. He hopes to calibrate the remote images with on-the-ground information and improve the accuracy and use of remote sensing for rangeland management.

The goal of these studies is to equip ranchers and others with information that improves decisions, such as how to maximize pastureland rotation and when to sell or purchase livestock.

"Every couple of months we get up at six in the morning and visit Jim," Crimmins said. "The big picture is to take what we learn on Jim Riggs' property and help create large-scale drought sensitivity maps."

Climate and Cattle

Most of the grasses on both Riggs' and Moroney's property sprout during the summer, making the monsoon thunderstorms vital for healthy rangelands. But winter precipitation is also important. The slow moving, widespread winter storms often saturate soils and set the stage for quick and widespread spring growth.

More than 30 species of grasses grow on both ranches. The diversity creates a buffer against short-term changes in climate. Some species are well adapted to surviving and rebounding after one dry season, and some can grow with less than a quarter-inch of rain. But none of the species grows in sufficient quantities to support a large ranch operation during successive years of drought, like those of the late 1800s, the 1950s, and the recent dry spell that began around 2000.

"Climate change has always been a factor in the Southwest. Anybody who makes a living directly on the landscape has to pay attention to it," Moroney said.

In 2002 and 2003, back-to-back seasons with insufficient rain forced Riggs, to reduce his stock of mother cows from about 190 to 90. As a result, his income nosedived by 75 percent. That's why ranchers like Riggs and Moroney are concerned about how climate may change.

"What can you do about something you can't exactly predict?" Moroney asked rhetorically. "I think about this constantly."

In a CLIMAS report published in 1999, researches surveyed many ranchers and concluded that, because summer rains are vital for grass growth, having a better understanding of the monsoon would greatly aid ranching decisions (view report: http://www.climas.arizona.edu/pubs/CL3-99.html). Unfortunately, monsoon forecasts are not refined enough yet to be useful. In the meantime, Riggs and Moroney are making their ranches resilient to climate change by keeping stocking numbers low, leaving some land ungrazed, and, for Moroney, diversifying his business by raising goats.

"In 20 years, if we have catastrophic climate change, goats and sheep may be more appropriate in this landscape than cows," he said. "If we experience more extreme weather, which is what many people predict, then we should prepare our ranch to deal with it."

For questions or comments, please contact Zack Guido, CLIMAS Associate Staff Scientist, at zguido@email.arizona.edu or (520) 882-0879.

Temperature (through 1/14/09)

Source: High Plains Regional Climate Center

Temperatures since the beginning of the 2009 water year on October 1, 2008 have averaged between 50 and 70 degrees Fahrenheit across the southwestern Arizona deserts and along the lower Colorado River (Figure 1a). In northeastern Arizona and for most of central New Mexico, average temperatures have been mostly between 40 and 50 degrees F, while the higher elevations generallyhave experienced temperatures in the upper 30s. In southern New Mexico, average temperatures have been in the low 40s and 50s. Since the water year began, temperatures have been warmer than average across the Southwest (Figure 1b). Arizona has been generally 1–3 degrees F above average, and as much as 4 degrees F above average in the higher elevations near Kingman, Page, and the White Mountains. Much of New Mexico has also been 1–3 degrees above average.

During the past 30 days, the temperature gradient has been from west to east, with western Arizona seeing temperatures of 0 to 6 degrees below average (Figures 1c–d). Eastern Arizona and western New Mexico have been 0–4 degrees warmer than average, and eastern New Mexico has been 2–6 degrees warmer than average. The temperature pattern is due to very cold December–January storm tracks that have crossed western Arizona moving from southwest to northeast. The storms missed southeastern Arizona and most of New Mexico, leaving those areas much warmer than average for this time of year.

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/maps/current/

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

Figure 1a. Water year '08–'09 (through January 14, 2009 average temperature.

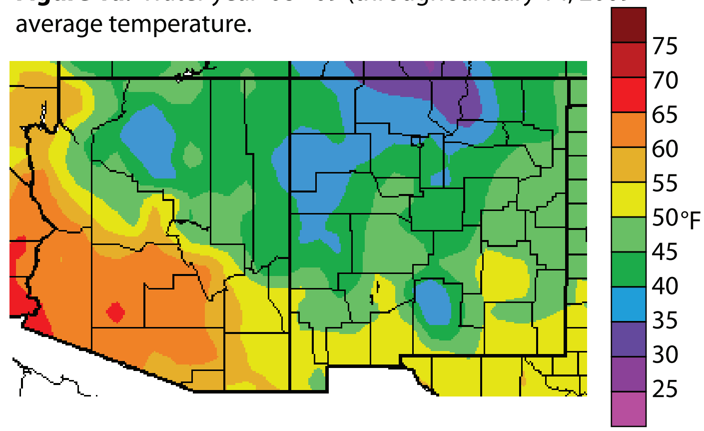


Figure 1b. Water year '08–'09 (through January 14, 2009) departure from average temperature.

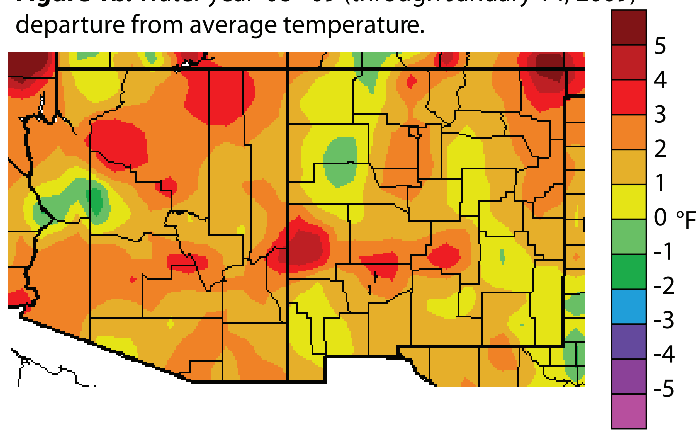


Figure 1c. Previous 30 days (December 16, 2008–January 14, 2009) departure from average temperature (interpolated).

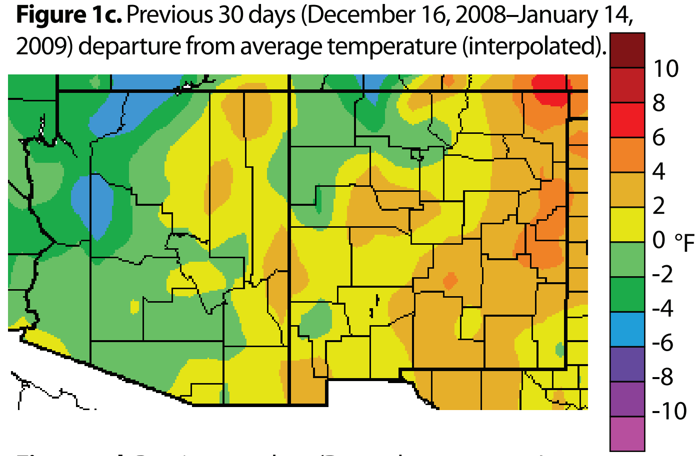
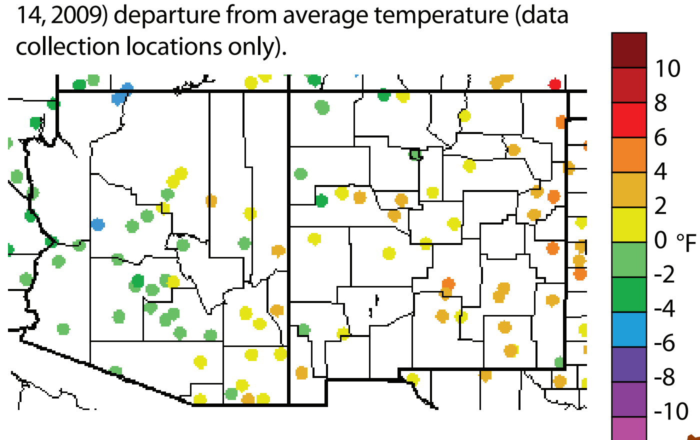


Figure 1d. Previous 30 days (December 16, 2008–January 14, 2009) departure from average temperature (data collection locations only).



Precipitation (through 1/14/09)

Source: High Plains Regional Climate Center

This water year, which began on October 1, has been characterized by high pressure systems over northern Mexico and the southwestern U.S. that have forced winter storms to the north of Arizona and New Mexico, leaving the southern borders relatively dry. As a result, a north-south precipitation gradient is evident, with higher precipitation falling in the north and tapering off toward the south (Figures 2a–b). The wettest areas are in New Mexico and have seen precipitation between 150 and 300 percent above-average. Arizona's wettest areas are in the northwest corner along the lower Colorado River and in the Salt River watershed in the east-central part of the state. The Colorado Plateau in northeastern Arizona, the southwestern deserts, and central New Mexico are drier than average. The driest areas are in southern New Mexico and southeastern Arizona, where precipitation has been between 5 and 50 percent of average.

In the past 30 days, a series of very cold, wet winter storms have passed across Arizona and northwestern New Mexico, dropping heavy snow and rain (Figures 2c–d). Most of Arizona received 100 to 400 percent of average precipitation for these 30 days, while much of New Mexico received then than 2 to 50 percent of average. The northwest corner of New Mexico received 200 to 800 percent of average precipitation.

Notes:

The water year begins on October 1 and ends on September 30 of the following year. As of October 1, 2008, we are in the 2009 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/maps/current/

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 '08–'09 (through January 14, 2009) percent of average precipitation (interpolated).

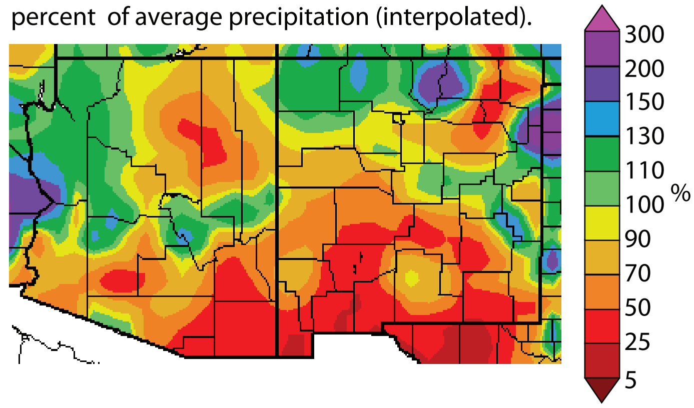


Figure 2b. Water year '08–'09 (through January 14, 2009) percent of average precipitation (data collection locations only).

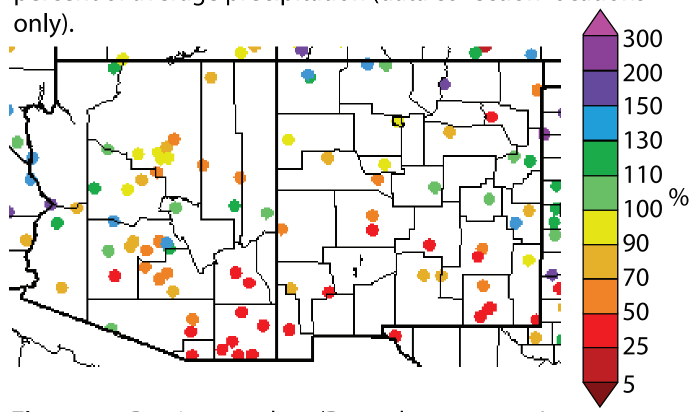


Figure 2c. Previous 30 days (December 16, 2008–January 14, 2009) percent of average precipitation (interpolated).

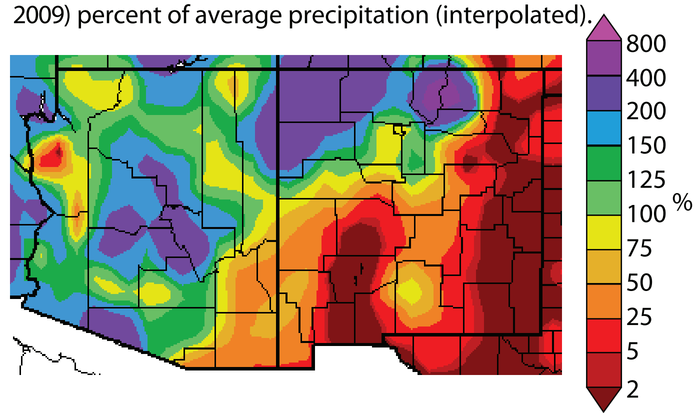
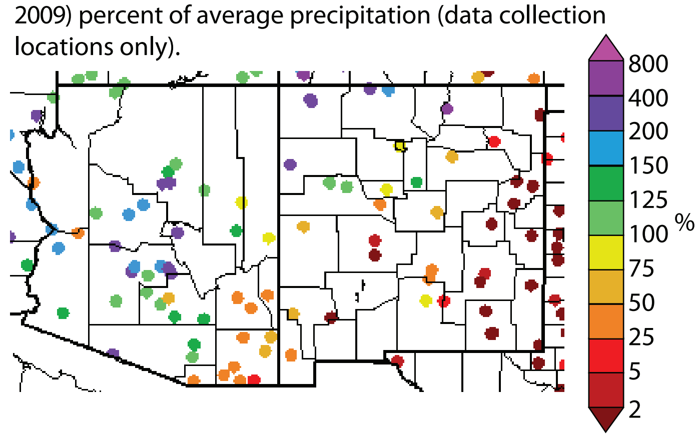


Figure 2d. Previous 30 days (December 16, 2008–January 14, 2009) percent of average precipitation (data collection locations only).



U.S. Drought Monitor

(released 1/15/09)

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

Drought conditions in Arizona and New Mexico substantially changed from the conditions reported in December (Figure 3). In Arizona, a swath of abnormally dry conditions persists in the north and central parts of the state, while drought conditions are no longer present in parts of west-central Arizona. In New Mexico, drought is no longer classified in some northern regions, particularly in the northwest corner. However, due to abnormally warm and dry conditions in the past 30 days, eastern New Mexico is now classified as abnormally dry.

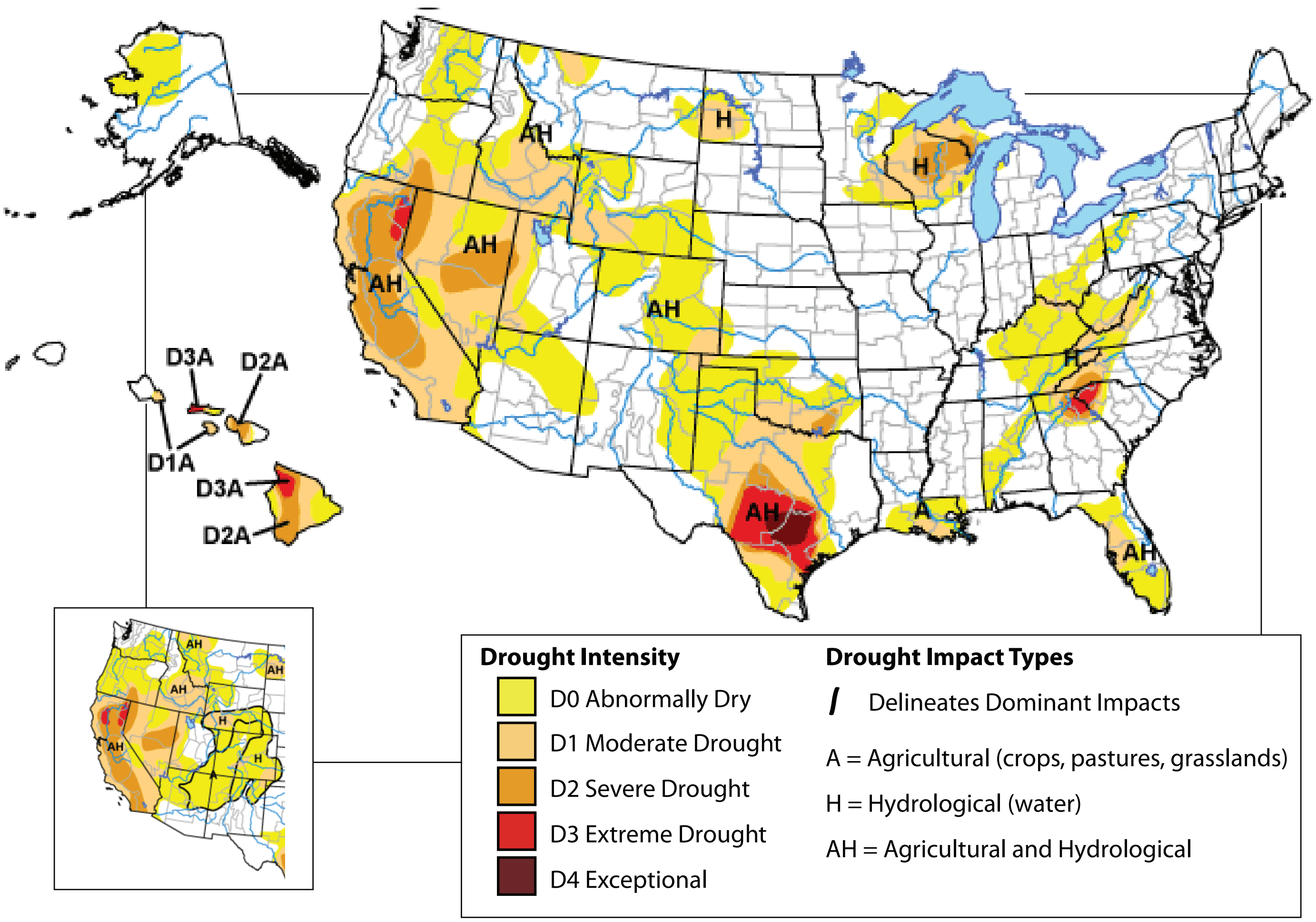
On January 13, approximately 62 percent of Arizona had no drought classification, while about 37 percent was abnormally dry and only 1 percent was classified with moderate drought intensity. In the past month, the total area in Arizona with a drought intensity decreased from about 60 percent to 39 percent. In New Mexico, about 70 percent of the state had no drought status on January 13. Only 28 percent was abnormally dry and about 2 percent had moderate drought intensity. In the past month, the total area in New Mexico classified with a drought intensity decreased by about 10 percent.

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 Laura Edwards, WRCC.

Figure 3. Drought Monitor released January 15, 2009 (full size), and December 18, 2008 (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

(data through 10/31/08)

Source: Arizona Department of Water Resources

Dry and warm conditions in November caused short-term drought conditions to worsen in several watersheds across Arizona. The November Arizona Drought Monitor Report noted that five watersheds in southern Arizona moved from normal status in October to abnormally dry conditions in November (Figure 4a). The Agua Fria and Little Colorado River watersheds moved from abnormally dry to moderate drought status over the same period.

Long-term drought conditions will be evaluated again with the upcoming January Drought Monitor Report. Most of the state is still experiencing abnormally dry to moderate long-term drought conditions reflected in the October update (Figure 4b).

In water news, U.S. and Mexican officials met in January to discuss Colorado River water sharing strategies during drought (denverpost.com, January 15). The meeting set the stage for ongoing discussions on how Mexico and the three lower basin states—Nevada, California, and Arizona—which currently consume a portion of the basin's water rights, could better coordinate Colorado River water management. Some proposed strategies include storing Mexican water allotments in U.S. reservoirs, reducing water deliveries to Mexico during severe drought, and building desalinization plants in Mexico.

Figure 4a. Arizona short-term drought status for November 2008.

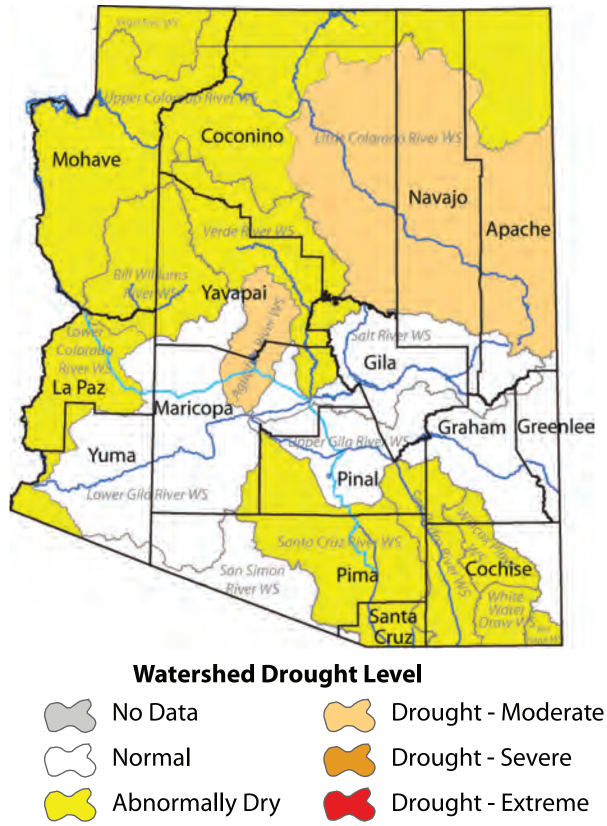
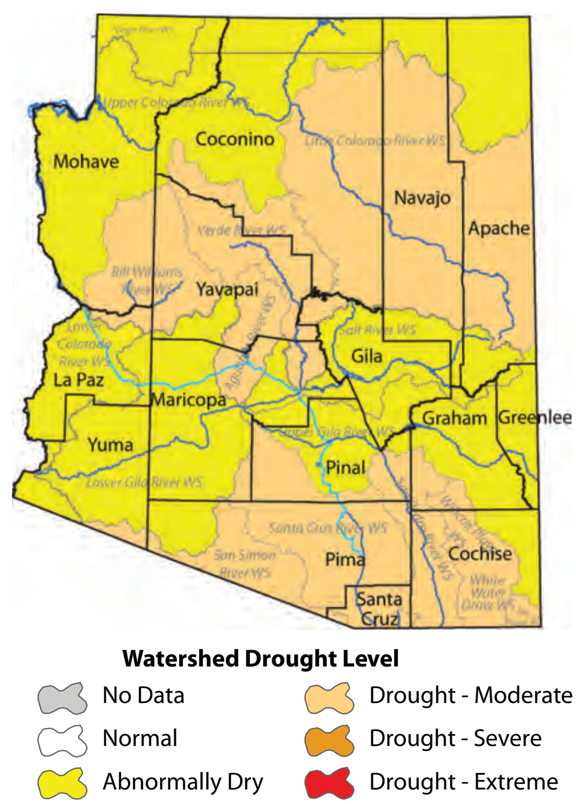


Figure 4b. Arizona long-term drought status for November 2008.



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/drought/DroughtStatus.html

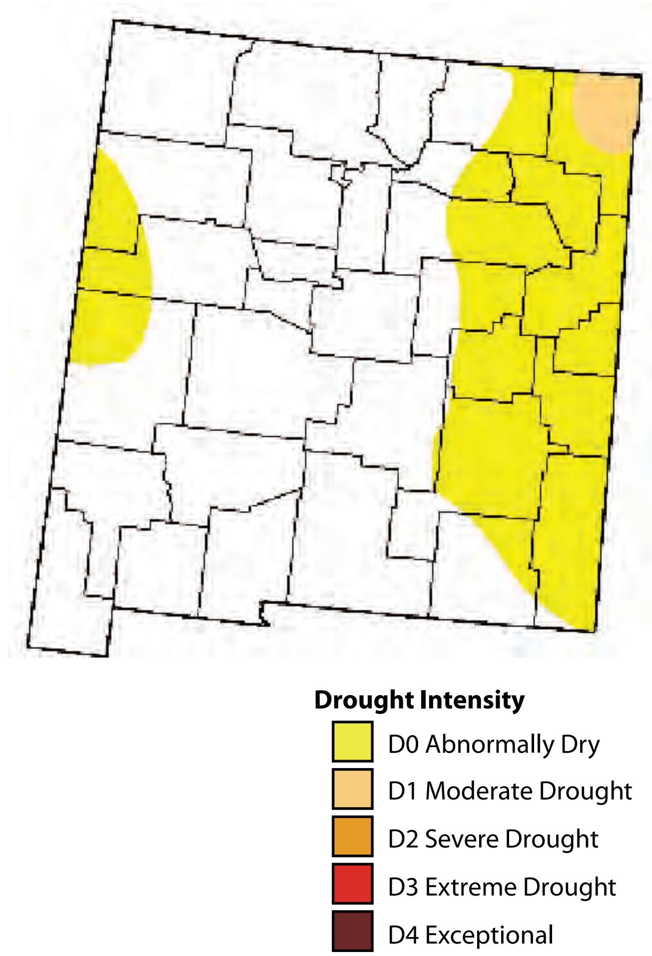
New Mexico Drought Status
(released 1/15/09)

Source: New Mexico State Drought Monitoring Committee

Drought conditions improved over much of northwestern New Mexico but worsened slightly across the eastern part of the state between November and January. The January 13 update of the National Drought Monitor shows abnormally dry conditions over much of the eastern third of the state with moderate drought in Union County in the extreme northeast (Figure 5). Overall, only 30 percent of the state is observing some kind of drought and 2 percent is classified at moderate drought or higher. The northwestern quarter of New Mexico has observed 150–200 percent of average precipitation over the past 60 days due to a persistent storm track that has brought multiple wet storms to the region. This recent precipitation has helped alleviate short-term drought conditions present in mid-November. On the other hand, the storm track missed much of eastern and southern New Mexico. Precipitation in these areas has been 25–50 percent of average precipitation, leading to the development of short-term drought across these regions.

A gradual shift from trees to grassland over the past 15 years has been observed at a monitoring site in northern New Mexico by a U.S. Geological Survey project (*Christian Science Monitor*, January 18). Craig Allen, the researcher in charge of the project, noted that recent drought conditions in New Mexico may be helping to shift the landscape back towards grasslands in areas now dominated by shrubs and trees. Allen suspects the site was once grassland, but overgrazing and fire suppression allowed woody vegetation to dominate the area. However, recent drought conditions and higher temperatures are killing the woody vegetation, leaving room for grass species to move back in. Allen notes that this shift will leave the area more resilient to future changes in climate because grasslands are more resilient to disturbances than shrubby lands.

Figure 5. New Mexico drought map based on data through January 13, 2009.



On the Web:
For the most current drought status map, visit:
http://www.drought.unl.edu/dm/DM_state.htm?NM,W

For the most current Drought Status Reports, visit:
http://www.nmdrought.state.nm.us/MonitoringWorkGroup/wk-monitoring.html

Notes:
The New Mexico section of the U.S. Drought Monitor is released weekly (every Thursday) and represents data collected through the previous Tuesday. The 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.

This summary contains substantial contributions from the New Mexico Drought Working Group.

Arizona Reservoir Levels
(through 12/31/08)

Source: National Water and Climate Center

Combined reservoir storage in Lakes Powell and Mead declined by 70,000 acre-feet during December (Figure 6). Storage in the Salt River watershed increased by 6 percent, while storage in the Verde River watershed increased by 12 percent; the combined storage in the Salt-Verde reservoir system increased by approximately 161,000 acre-feet during December.

U.S. Senator John McCain met privately with leaders of the Verde River Basin Partnership and Prescott City Council to try to rescue the Verde River basin partnership. The organization organizes studies to increase the accuracy of a U.S. Geological Survey computer model designed to help identify the best locations for municipal wells and groundwater recharge (*Camp Verde Bugle*, January 2).

Scientists reported further growth of infrastructure-damaging quagga mussels in Lake Mead (*Las Vegas Review-Journal*, January 13).

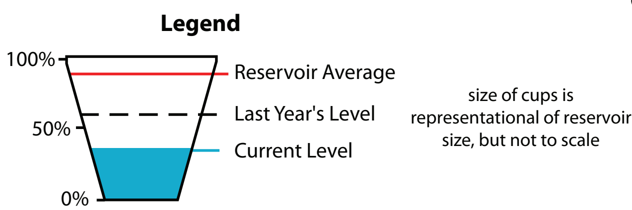
Notes:

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. One acre-foot is the volume of water sufficient to cover an acre of land to a depth of 1 foot (approximately 325,851 gallons). On average, 1 acre-foot of water is enough to meet the demands of 4 people for a year. The last column of the table list an increase or decrease in storage since last month. A line indicates no change.

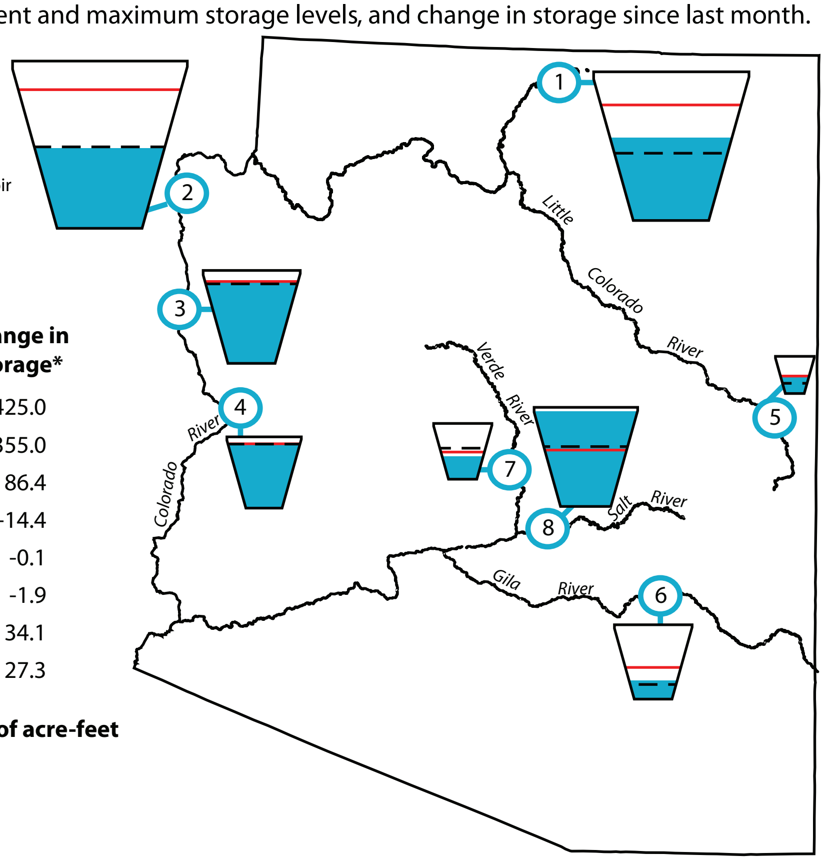
These data are based on reservoir reports updated monthly by the National Water and Climate Center of the U.S. Department of Agriculture's Natural Resource Conservation Service (NRCS). For additional information, contact Dino DeSimone, Dino.DeSimone@az.usda.gov.

Figure 6. Arizona reservoir levels for December 2008 as a percent of capacity. The map 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	56%	13,541.0	24,322.0	-425.0
2. Lake Mead	48%	12,512.0	26,159.0	355.0
3. Lake Mohave	87%	1,580.7	1,810.0	86.4
4. Lake Havasu	90%	556.9	619.0	-14.4
5. Lyman Reservoir	47%	14.2	30.0	-0.1
6. San Carlos	25%	216.7	875.0	-1.9
7. Verde River System	41%	118.0	287.4	34.1
8. Salt River System	96%	1,954.0	2,025.8	127.3

*** 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 12/31/08)

Source: National Water and Climate Center

The total reservoir storage in New Mexico decreased slightly during December (Figure 7). Water storage in Rio Grande Basin reservoirs increased by approximately 12,000 acre-feet, and storage in Pecos River reservoirs rose by approximately 7,000 acre-feet during December.

The U.S. Senate voted 66–12 to move forward with a major package of bills, sponsored by U.S. Senator Jeff Bingaman, that benefit the Navajo Nation and New Mexico (*Gallup Independent*, January 12). The bills will settle Navajo Nation water rights claims to approximately 600,000 acre-feet per year in the San Juan River Basin. The package also authorizes federal funding for the Navajo-Gallup Water Supply Project. In addition, the U.S. Senate voted 73–21 to authorize the Bureau of Reclamation to spend up to $327 million to assist the Eastern New Mexico Rural Water Authority and about 160 others to pipe water from Quay County to other counties in New Mexico (*Clovis News Journal*, January 15).

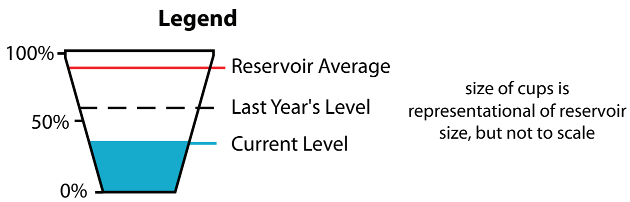
Notes:

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).

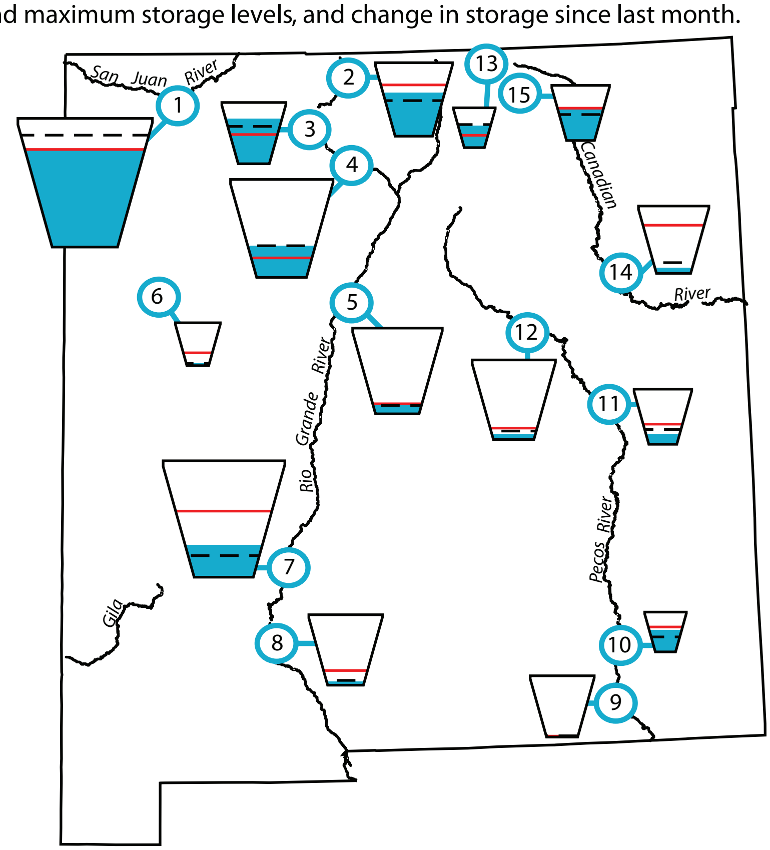
The table details more exactly the current capacity level (listed as a percent of maximum storage). Current and maximum storage levels are given in thousands of acre-feet for each reservoir. One acre-foot is the volume of water sufficient to cover an acre of land to a depth of 1 foot (approximately 325,851 gallons). On average, 1 acre-foot of water is enough to meet the demands of 4 people for a year. 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 (NRCS). For additional information, contact Richard Armijo, Richard.Armijo@nm.usda.gov.

Figure 7. New Mexico reservoir levels for December 2008 as a percent of capacity. The map depicts the average level and last year's storage for each reservoir. The table also lists current and maximum storage levels, and change in storage since last month.



Reservoir Name	Capacity Level	Current Storage*	Max Storage*	Change in Storage*
1. Navajo	75%	1,277.9	1,696.0	-15.9
2. Heron	60%	241.9	400.0	-30.1
3. El Vado	74%	144.9	195.0	0.0
4. Abiquiu	33%	182.0	554.5	5.2
5. Cochiti	10%	51.0	491.0	1.1
6. Bluewater	5%	1.9	38.5	-0.5
7. Elephant Butte	28%	617.2	2,195.0	19.4
8. Caballo	6%	21.4	332.0	1.6
9. Brantley	2%	18.5	1008.2	2.4
10. Lake Avalon	55%	2.2	4.0	0.7
11. Sumner	18%	18.8	102.0	3.5
12. Santa Rosa	7%	31.1	438.3	0.5
13. Costilla	56%	8.9	16.0	0.5
14. Conchas	8%	21.6	254.2	0.4
15. Eagle Nest	58%	46.1	79.0	0.7



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 1/15/09)

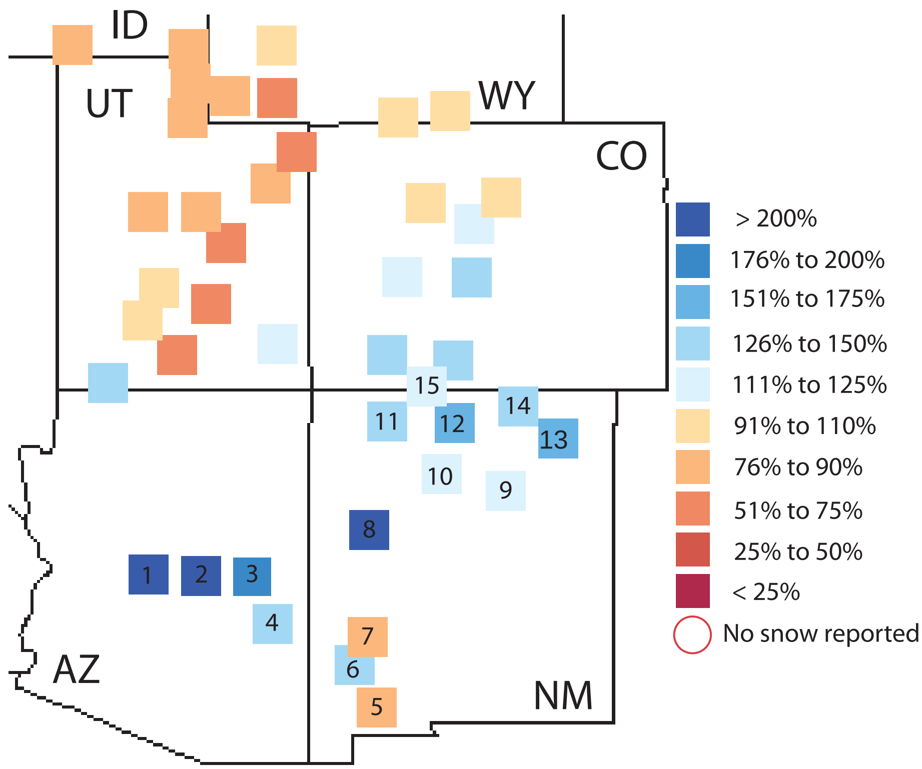
Sources: National Water and Climate Center, Western Regional Climate Center

Storms in December filled the Verde, Salt, Gila, and Lower Colorado river basins with snow. Official reports from SNOTEL stations on January 1 indicated that the basin snow water equivalent (SWE) in these basins was between 131 and 334 percent of average (Figure 8).

Northern New Mexico has also fared well, with most watersheds observing SWE values ranging from 100 to 175 percent of average. Basins in southwestern New Mexico were reporting below-average values as of mid-January. The Gila River watershed was at 86 percent of average and the Mimbres River watershed was at 89 percent of average. Forecasters are concerned that the early snowfall may not be followed by additional precipitation necessary to maintain current snowpack levels. In addition, winter precipitation may be low because La Niña conditions characterize sea surface temperatures in the tropical Pacific Ocean. In the headwaters of the Colorado River, SWE reported on or before January 16 at SNOTEL stations is generally above average. For example, in the San Juan, Gunnison, and Upper Colorado river watersheds, SWE is 122, 116, and 115 percent above average, respectively.

December snowfall for the San Juan Mountains around Silverton, Colorado, was record breaking. The storm that arrived on Christmas pounded the high country with blizzard-like conditions, filling the upper San Juan River Basin with more than three feet of snow. (*Rocky Mountain News*, December 27).

Figure 8. Average snow water content (SWC) in percent of average for available monitoring sites as of January 15, 2009.



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

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

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.

Temperature Outlook

(February–July 2009)

Source: NOAA Climate Prediction Center (CPC)

The NOAA Climate Prediction Center (CPC) long-lead temperature forecasts for the continental U.S. and Alaska show increased chances of above-normal temperatures for much of the Southwest through the spring and into summer 2009 (Figures 9a–d). The forecast predicts Arizona will have a fairly high chance (up to 60 percent) of experiencing temperatures that are above the climatological average through much of the summer. These long-lead forecasts, therefore, reflect both long-term warming trends and expected winter and spring La Niña conditions, which are typically warmer and drier in much of the Southwest.

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 February–April 2009.

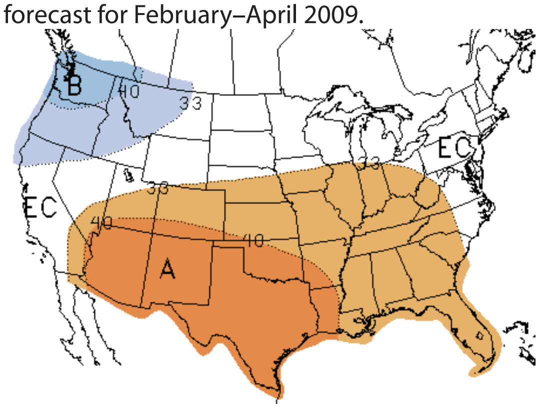
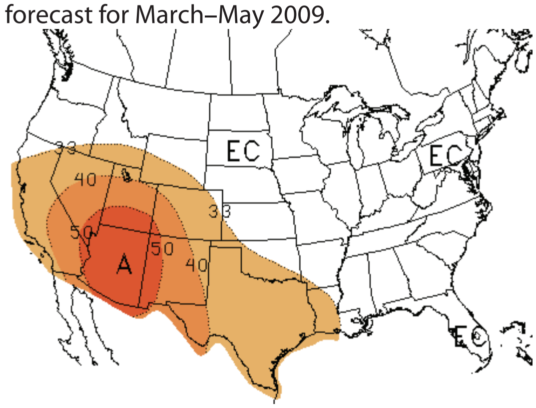


Figure 9b. Long-lead national temperature forecast for March–May 2009.



A= Above
50.0–59.9%
40.0–49.9%
33.3–39.9%

B=Below
40.0–49.9%
33.3–39.9%

Figure 9c. Long-lead national temperature forecast for April–June 2009.

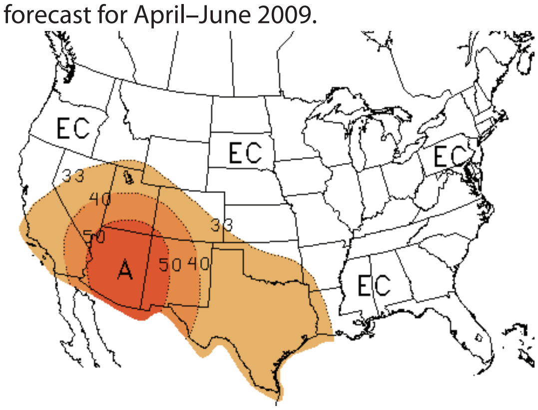
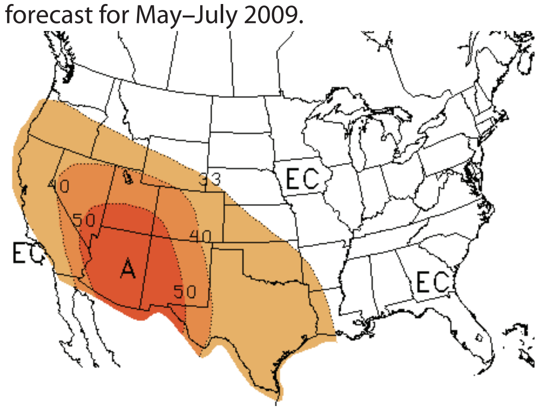


Figure 9d. Long-lead national temperature forecast for May–July 2009.



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

(February–July 2009)

Source: NOAA Climate Prediction Center (CPC)

The NOAA Climate Prediction Center precipitation forecasts through May 2009 show slightly increased chances of below-average precipitation for Arizona and New Mexico as well as much of the Southeast U.S. (Figures 10a–b). The greatest chances of below-average precipitation in the Southwest are in central and southern New Mexico through April (Figure 10a) and the Four Corners region through June (Figures 10b–c). The forecast shifts to equal chances of above-, below-, and near-normal precipitation through July for most of the Southwest (Figures10d). The equatorial Pacific sea surface temperatures began to exhibit signs of developing La Niña conditions in December, and this now-weak La Niña is expected to continue through the spring (see Figures 13a–b). The La Niña signal is much less useful for predicting summer precipitation through most of the Southwest due to complexities associated with the North American Monsoon.

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 February–April 2009.

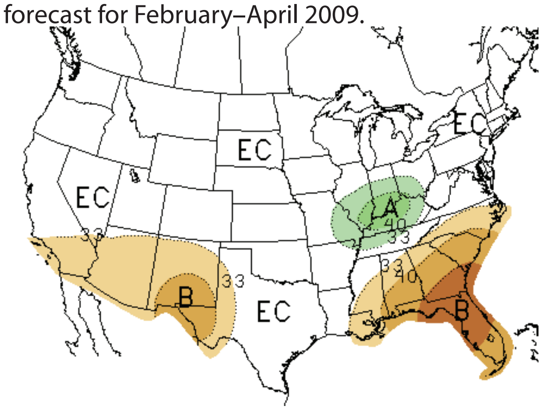


Figure 10b. Long-lead national precipitation forecast for March–May 2009.

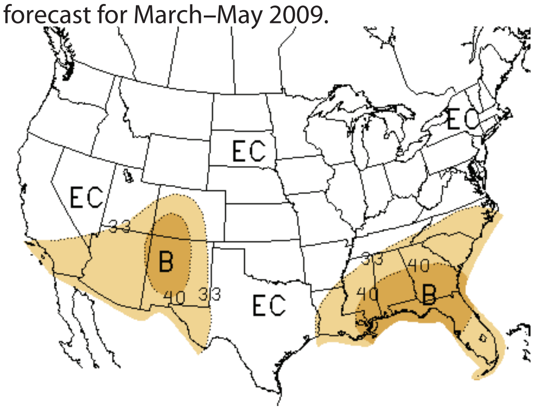


Figure 10c. Long-lead national precipitation forecast for April–June 2009.

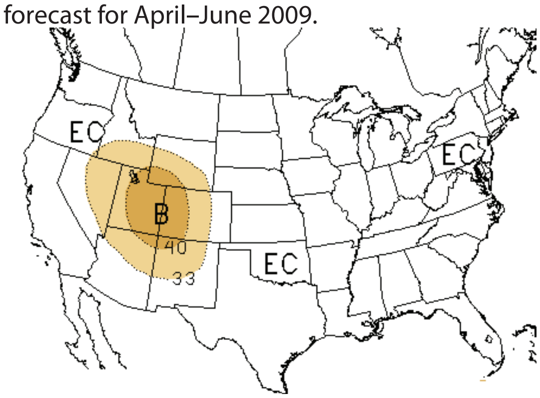
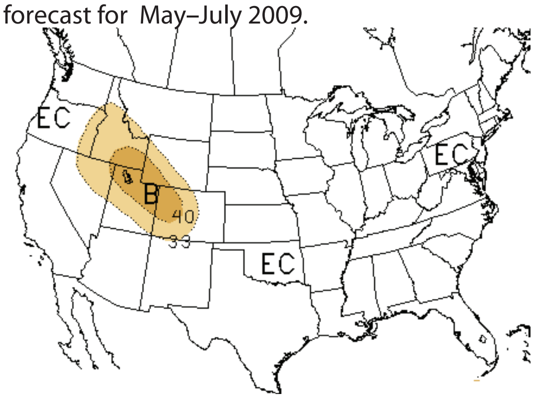


Figure 10d. Long-lead national precipitation forecast for May–July 2009.



B= Below: 33.3–39.9%, 40.0–49.9%, 50.0–59.9%

A=Above: 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/

Seasonal Drought Outlook
(through April 2009)

Source: NOAA Climate Prediction Center (CPC)

The National Oceanic and Atmospheric Administration's Climate Prediction Center (CPC) reports that drought conditions for January 15 through April will generally persist or intensify in most of California and Nevada and in central Texas (Figure 11). Drought also will develop in central Texas and parts of the Southeast. Drought improvements will likely occur in Hawaii, North Dakota, parts of the Great Lakes region, and in the southern Appalachian Mountains. Drought will likely persist in southern Idaho and Wyoming, other areas of the Great Lakes region, and in areas of the Southeast.

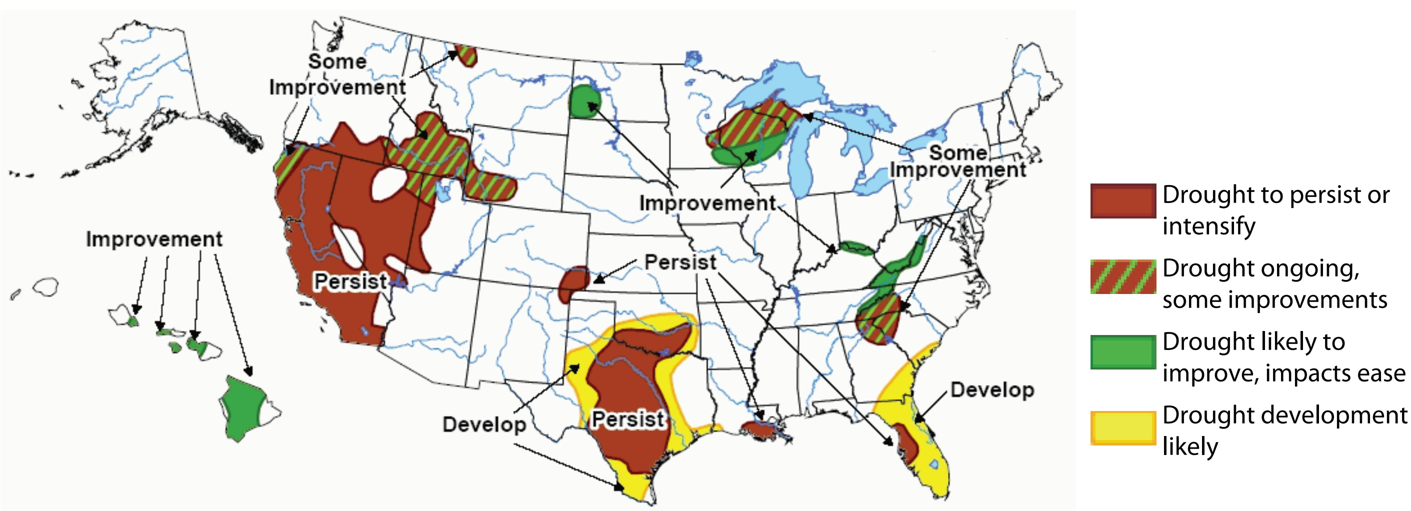
Most of Arizona and New Mexico are not currently experiencing short-term drought conditions, and the CPC forecast for both states does not call for drought conditions to develop. This forecast is in part due to the historical occurrence of winter storms during this time period. Drought will persist in only a few small areas located in New Mexico's northeast corner and along the Colorado River in Arizona. In southeast Colorado, the historical climate favors drought persistence. The CPC has moderate confidence in the drought persistence forecast for southeast Colorado and northeast New Mexico.

In other areas in the U.S., the CPC forecasts the persistence of drought for much of California primarily because the main storm track is forecast to shift north in the late winter, causing precipitation to occur mostly in Oregon and Washington. Across the northern tier of states, signals from La Niña composites favor some improvement for northwest Montana and southwestern North Dakota. In the southern Atlantic region, drier conditions recently have prevailed, causing abnormally low streamflow values. Also in this region, the February to April precipitation forecast shows a tilt in the odds to drier-than-normal conditions, which is consistent with historical La Niña events. As a result, the forecast for the Southeast is for drought conditions to expand from Florida into coastal Georgia and South Carolina.

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 April 2009 (released January 15, 2009).



On the Web:

For more information, visit:
http://www.drought.gov/portal/server.pt

Streamflow Forecast
(for spring and summer)

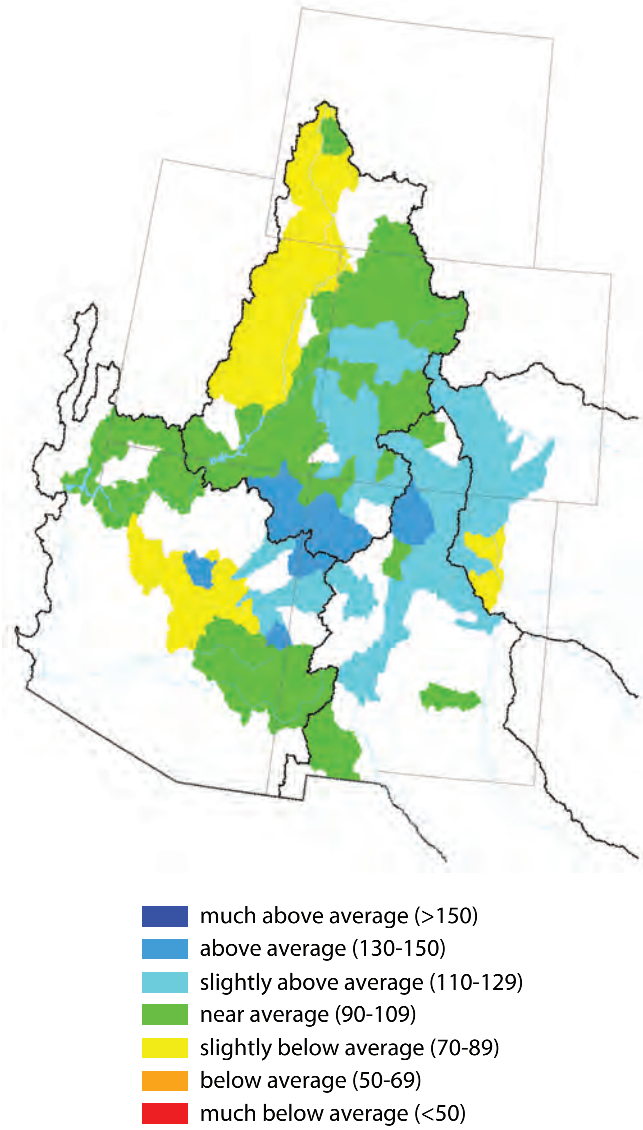
Source: National Water and Climate Center

The first spring-summer 2009 streamflow forecast for the Southwest shows near-average to above-average flows for most basins in Arizona and New Mexico (Figure 12). There is at least a 50 percent chance that inflow to Lake Powell will be 101 percent of the 30-year average for April–July. Predictions for streams in the Chuska and Little Colorado watersheds call for above-average flows through the spring. For the Salt, Verde, and Gila river watersheds, near-average to average flows are predicted. In New Mexico, forecasts indicate above-average spring-summer flows for virtually all streams in the state. The USDA Natural Resources Conservation Service (NRCS) cautions that "this early in the season, it's a tough call and [streamflow volumes] could fall out either way before the snow season is said and done."

In water news, water usage per person for metropolitan area customers of the Albuquerque Bernalillo County Water Authority is down to 161 gallons, which is the lowest on record (*New Mexico Business Weekly*, January 13).

Backed by the federal government, the White Mountain Apache tribe has claimed rights to approximately 175,000 acre-feet from the Black and White rivers, which join to form the Salt River (*Arizona Republic*, January 16). The claims are part of a deal to settle more than 50 years of negotiations on water rights in the headwaters of the Salt River. Terms of the deal include a package of groundwater from the watersheds of the Salt and Little Colorado rivers and 25,000 acre-feet per year of Colorado River water delivered via the Central Arizona Project. The tribe may also build a small reservoir on the White River.

Figure 12. Spring and summer streamflow forecast as of January 1, 2009 (percent of average).



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.

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

El Niño Status and Forecast

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

Sea surface temperatures (SSTs) cooled across much of the equatorial Pacific Ocean through December and early January, leading to the official declaration by NOAA-Climate Prediction Center (NOAA-CPC) in early January 2009 of a La Niña event. Stronger-than-average easterly winds along the equatorial Pacific helped enhance the upwelling of cold water in the eastern Pacific, lowering SSTs below the threshold for a La Niña event. Suppressed tropical thunderstorm activity near the International Date Line and enhanced activity in the western Pacific are also signs of developing La Niña conditions. The Southern Oscillation Index (SOI) remained positive and relatively high again in December at 1.5, a sign that atmospheric circulation patterns are helping to reinforce La Niña conditions (Figure 13a). The International Research Institute for Climate and Society (IRI) notes that the development of these La Niña conditions was very late in the season, which is often not favorable for sustaining events beyond a couple of months. IRI suggests that this present La Niña event may be very brief and similar to other short-lived cool events observed in 2000–2001 and 2005–2006.

Forecasts produced by IRI indicate a 55 percent chance of La Niña conditions continuing through the January–March period, compared to a 44 percent chance of ENSO-neutral conditions and 1 percent chance of an El Niño event developing (Figure 13b). IRI forecasts suggest that the La Niña event will likely not last past early winter. The chance of ENSO-neutral conditions returning rises to 65 percent by the April–June period, relative to a 25 percent chance of La Niña conditions continuing. Even with the quick onset and potentially brief life of the current La Niña, the NOAA-CPC expects to see typical wintertime impacts emerge across the continental U.S. Increased chances of below-average precipitation are forecast for the Southwest U.S. due in large part to the recent shift towards La Niña conditions.

Notes:

Figure 13a shows the standardized three month running average values of the Southern Oscillation Index (SOI) from January 1980 through December 2008. 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 and Society (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 13a. The standardized values of the Southern Oscillation Index from January 1980–December 2008. 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).

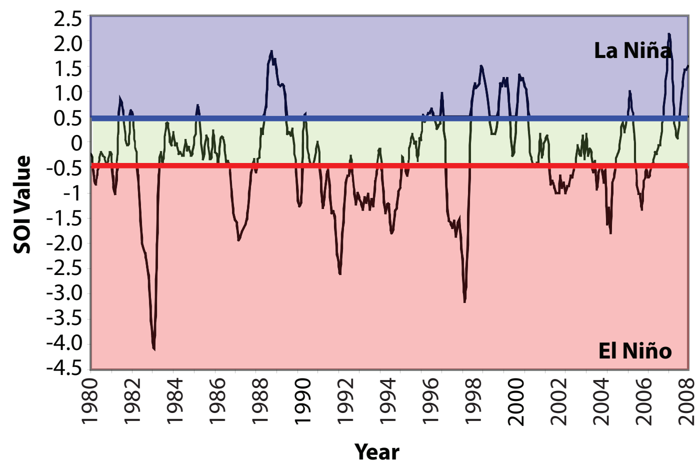
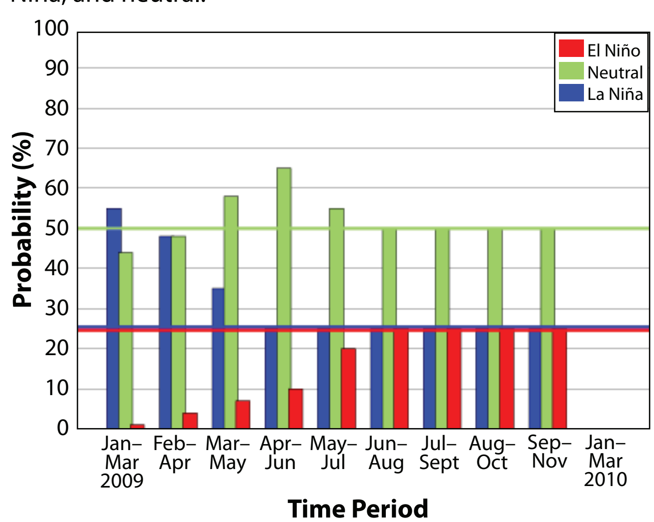


Figure 13b. IRI probabilistic ENSO forecast for El Niño 3.4 monitoring region (released January 15, 2009). Colored lines represent average historical probability of El Niño, La Niña, and neutral.



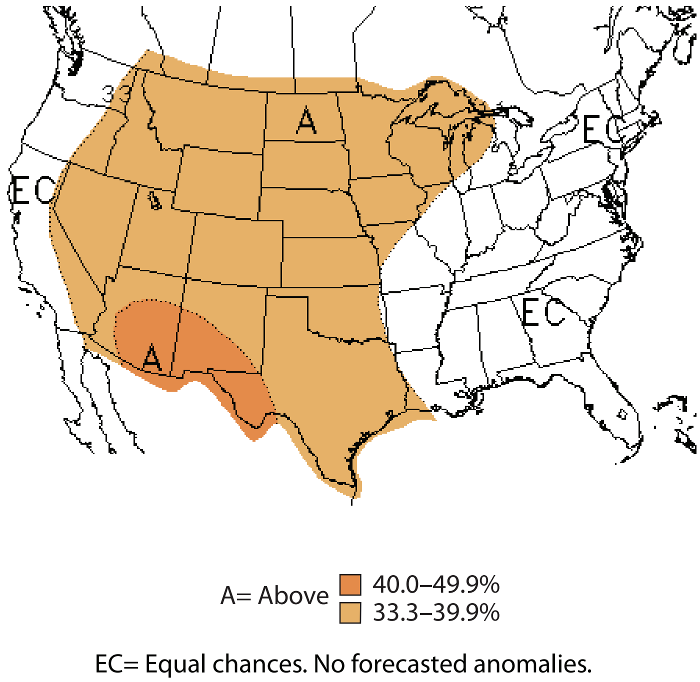
Temperature Verification

(October–December 2008)

Source: NOAA Climate Prediction Center (CPC)

The NOAA-Climate Prediction Center (CPC) seasonal temperature outlook for October–December 2008 predicted increased chances of above-average temperatures for much of the western United States, including more than a 40 percent chance that parts of Arizona and New Mexico would experience above-average temperatures (Figure 14a). These predictions were based primarily on long-term temperature trends. The overall observed pattern of temperatures from October through December was consistent with the CPC prediction, with temperatures slightly above average through most of the West and slightly cooler east of the Mississippi (Figure 14b). With the El Niño-Southern Oscillation (ENSO) in the neutral phase through much of the forecast period, these forecasts were based primarily on long-term trends in temperature.

Figure 14a. Long-lead U.S. temperature forecast for October–December 2008 (issued September 2008).



Notes:

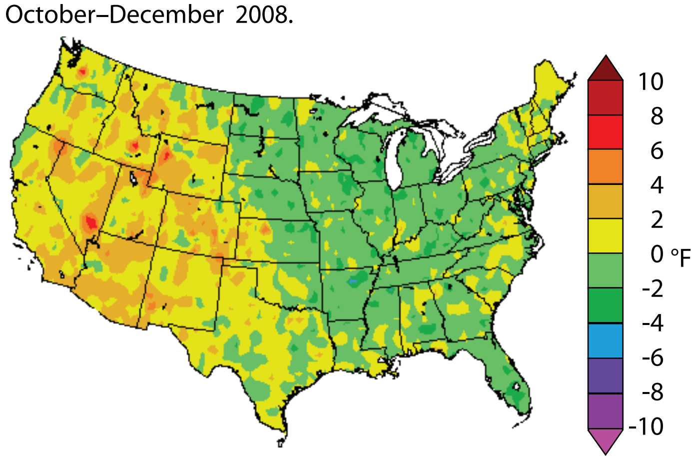
Figure 14a shows the NOAA Climate Prediction Center (CPC) temperature outlook for the months October–December 2008. This forecast was made in September 2008.

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 October–December 2008 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 14b. Average temperature departure (in degrees F) for October–December 2008.



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
(October–December 2008)

Source: NOAA Climate Prediction Center (CPC)

The NOAA-Climate Prediction Center (CPC) seasonal precipitation outlook for October–December 2008 predicted equal chances of near-, above-, and below-average precipitation through most of the U.S., with a slightly greater chance of below-average precipitation in the Southwest (Figure 15a). Observed precipitation revealed very dry conditions through most of the region, with southern Arizona and southern New Mexico experiencing quite dry conditions (Figure 15b). The forecast was generally consistent with the dry conditions in parts of the Southwest.

Figure 15a. Long-lead U.S. precipitation forecast for October–December 2008 (issued September 2008).

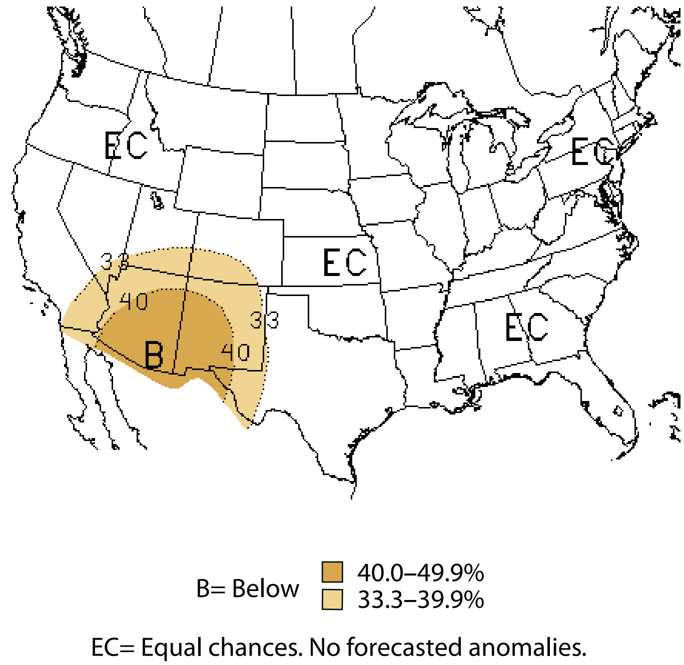
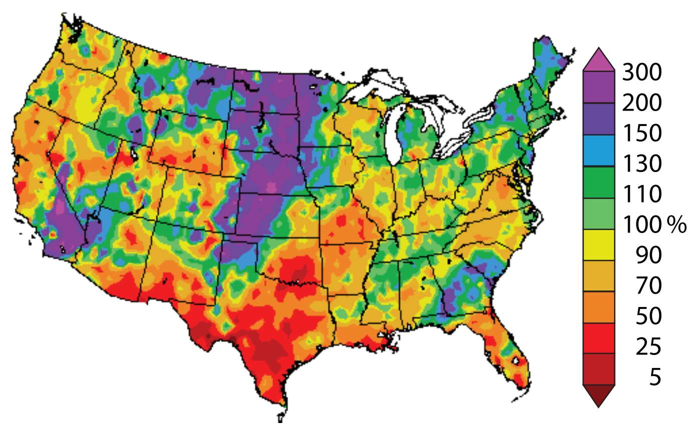


Figure 15b. Percent of average precipitation observed from October–December 2008.



Notes:

Figure 15a shows the NOAA Climate Prediction Center (CPC) precipitation outlook for the months October–December 2008. This forecast was made in September 2008.

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 October–December 2008. Care should be exercised when comparing the forecast (probability) map with the observed precipitation maps. The observed precipitation amounts do not represent probability classes as in the forecast maps, so they are not strictly comparable, but they do provide us with some idea of how well the forecast performed.

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

On the Web:

For more information on CPC forecasts, visit:
http://www.cpc.ncep.noaa.gov/products/predictions/multi_season/13_seasonal_outlooks/color/churchill.html