Issued: February 27, 2008

Southwest Climate Outlook

The University of Arizona.

Source: Kristen Nelson, ISPE

Photo Description: The first flowers of what is predicted to be a good wildflower season around Tucson, Arizona this spring, have begun to bloom. This photo of verbena was taken February 27 at The University of Arizona. Updates of the wildflower season are posted online by the Arizona Sonora Desert Museum and can be found at http://www.desertmuseum.org/programs/flw_blooming.html.

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

In this issue...

February Climate Summary

Drought – Wet conditions in December and January have resulted in marked improvements in short-term drought across Arizona. New Mexico has missed many of these storms with most of the southeastern corner of the state only observing 25 percent of average precipitation in the past thirty days.

Temperature – Temperatures have generally been below-average across most of Arizona and northern New Mexico over the past thirty days. Southeast New Mexico has been relatively warm, with temperatures measuring above-average for the same period.

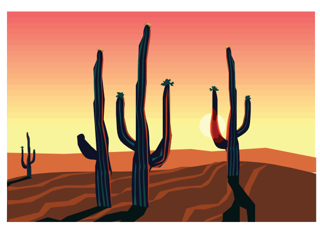
Precipitation – Much of Arizona and northern New Mexico observed very wet conditions over the past thirty days with many locations reporting 150 to 200 percent of average. Southeastern Arizona and much of southern New Mexico have been drier, with less than 100 percent of average precipitation observed.

ENSO – La Niña conditions strengthened this past month with sea surface temperatures over 2 degrees Celsius below-average in the central Pacific Ocean and the Southern Oscillation Index falling to -1.9 by the end of January. Forecasts indicate a strong likelihood that La Niña conditions will persist into the spring.

Climate Forecasts – Seasonal climate forecasts continue to project dry and warm conditions across the Southwest into the spring. The La Niña event is to blame for the below-average precipitation forecast and for the above-average temperature forecast.

The Bottom Line – Wet conditions across much of Arizona continued into January due to a persistent storm track . Southeast Arizona and much of southern New Mexico has missed out on the precipitation from these recent storms. This has prompted an expansion of abnormally dry drought status across the region on the National Drought Monitor. The current La Niña event is expected to persist into the spring.

Climate and Deserts Workshop



The Climate and Deserts Workshop, "Adaptive Management of Desert Ecosystems in a Changing Climate," will be held April 9–11, in Laughlin, Nevada. The conference will bring together agency and university scientists and land and water managers to discuss emerging research and develop decision-making tools for adaptive desert ecosystem management. The workshop includes a number of topics, including ecosystem response, modeling, human uses, water, invasive plants, fire regimes, and wildlife. Registration is available online through April 2 and onsite at the workshop, but the early registration discount ends March 17. The price includes workshop participation, materials, breaks, lunches, and evening poster sessions. The workshop is sponsored by a consortium of agencies, including University of Arizona Cooperative Extension and CLIMAS.

For more information, registration, and the workshop agenda, visit http://www.cals.arizona.edu/climate/...

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

New streamflow forecasts for expert users

National Weather Service western water supply services

By Kevin Werner

The National Weather Service (NWS) has combined a number of forecast tools into a powerful new collection of web-based, site-specific maps and graphs that provide expert forecast users with a much greater depth of information about streamflow than ever before.

Streamflow forecasts are critical for making the best decisions related to water management, recreation, hydropower, agriculture, and natural hazards, like floods. Streamflow is water from rainfall or snowmelt that flows over land, usually in rivers and streams. The NWS's new suite of tools, available at http://www.nwrfc.noaa.gov/westernwater/, allows users to access NWS predictions and historical forecasts to help make these decisions and more effectively manage the limited water resources of the western United States.

Released this month, the new online service uses interactive maps, forecast analysis tools, and forecast verification tools to provide improved access to the official water supply forecasts, and forecast uncertainty—the probability that inflow will fall within a certain range, for example. It also allows users to access the long-term accuracy of forecasts. An overview of the new tools is presented here.

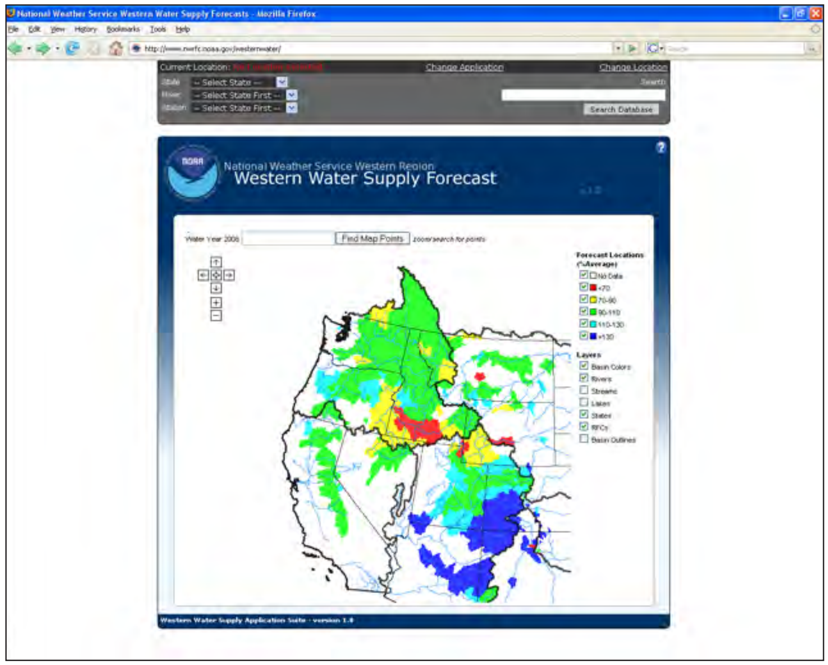

Figure 1a. The NWS western water supply map before any options are selected.

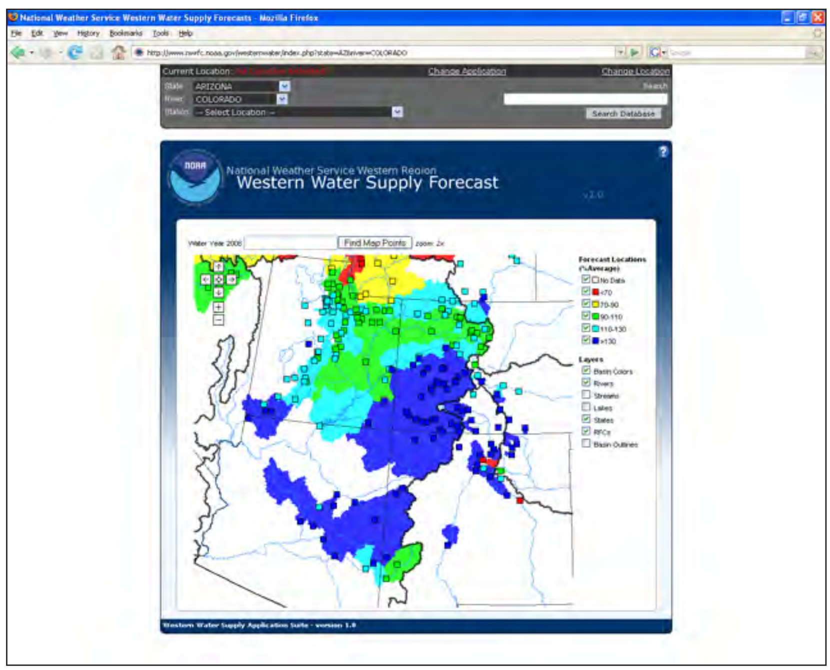

Figure 1a. The NWS western water supply map zoomed in on Arizona and the Colorado River.

Water Supply Maps

Forecasts are presented in both space and time through the NWS western water supply map (Figure 1a–b). The map, color-coded by percent of average runoff levels, presents the most recent forecast or observed spring runoff from the current water year. By clicking on a state or entering or selecting keywords in one of the search fields, users may zoom into geographical areas to find individual forecast points and basin boundaries and can apply optional lake, stream, state, and other layers. When users click on a forecast point, a mouse-over box displays the name of the location, the forecast in thousands of acre-feet (kaf), the date and period of the forecast, and other basin data, including the historical mean, minimum, and maximum runoff from that basin. Users can navigate between the various other tools by clicking the "Change Application" button at the top of the screen and then the desired application. Guides explaining how to use and interpret the maps and graphs are available for

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Streamflow, continued

each application under the "About Western Water" tab.

Forecast Evolution
The forecast evolution plot shows a graph displaying the time evolution of individual forecasts (Figure 2). This plot was developed in coordination with forecast users in the Pacific Northwest who needed to know how forecasts change over time with monthly and seasonally observed streamflow. This configurable plot allows users to graph forecasts; Ensemble Streamflow Prediction (ESP) forecasts, which are used to make probabilistic forecasts of up to ninety days for streamflow volume; and observed streamflow on a single plot for the current water year and past water years. A water year runs from October 1 through September 30. The graphs display the monthly statistical range of the forecasts for seasonal streamflow volume, the accumulation of monthly average volumes for the water year and the forecast period, and the accumulation of monthly observed volumes for the water year. Users can access this tool by clicking on the desired forecast location box on the map.

Ensemble Forecasts
Ensemble streamflow forecasts are presented through a highly interactive application that allows users to create plots showing forecast probabilities of streamflow volume month by month or for a season of their choice (Figure 3). This application also incorporates historical streamflow data, El Niño Southern Oscillation (ENSO) conditions, and forecast ensemble information.

Users can combine information to address questions about forecast uncertainty and the effects of the current soil moisture states and ENSO conditions on the current forecast. One of the useful aspects of this tool is the ability to overlay different years and ENSO conditions and see the results simultaneously, allowing for easy comparisons.

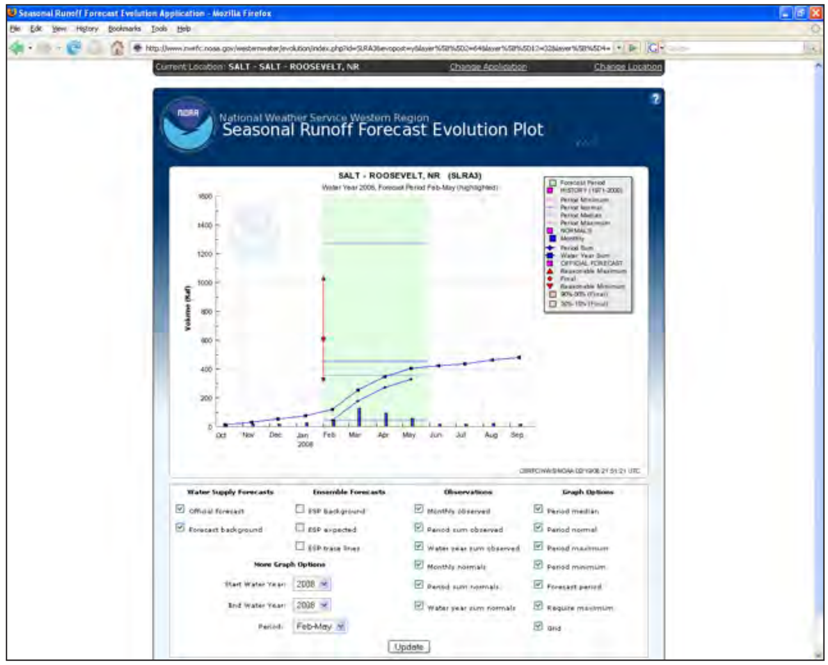

Figure 2. Forecast Evolution plot for the Salt- Roosevelt, NR forecast location in central Arizona.

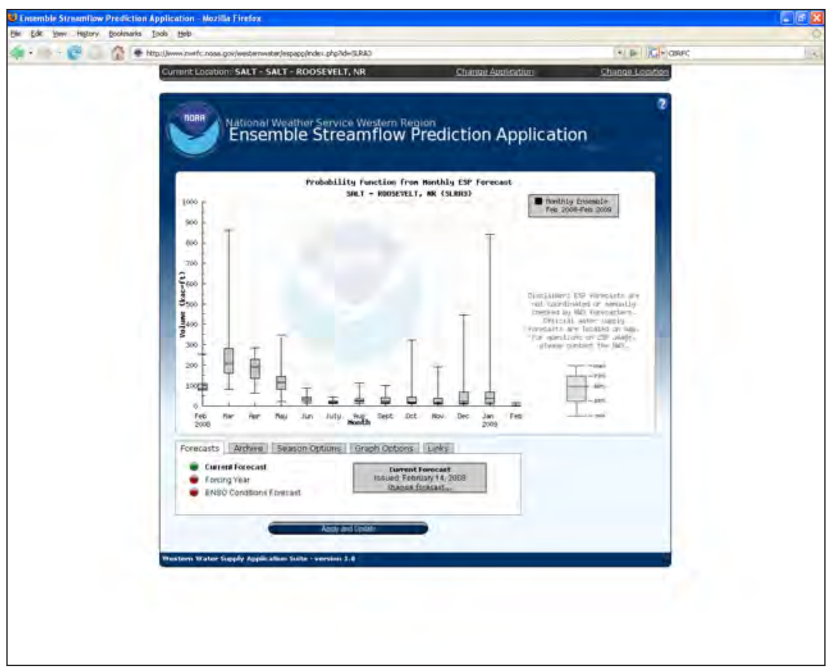

Figure 3. Ensemble streamflow forecasts for the Salt-Roosevelt, NR forecast location in central Arizona.

More information about ensemble forecasts in general can be found on the Climate Assessment for the Southwest (CLIMAS) website at http://www.climas.arizona.edu/pubs/update/may2002.pdf and http://www.climas.arizona.edu/research/forecasts/ensemble_wso.html.

Verification
A simple, interactive forecast evaluation tool is included for users to assess the quality of past coordinated, NWS, Natural Resources Conservation Service, and Statistical Water Supply forecasts. Simple forecast verification metrics including error and skill score

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Streamflow, continued

are included as well as an ability to visually explore past forecasts and observed streamflow. The verification application is important; research by the CLIMAS project found that stakeholders will not use a forecast that does not include an indication of its skill.

Data Check Out
Actual forecast and observed streamflow data is provided in text format to users through this application. Users may download data for their own purposes. In particular, the ensemble streamflow forecast data may be used for downstream applications involving decision support software.

The NWS is exploring the expansion of these services. Future development possibilities include a climate change scenario application that would leverage climate change scenarios from the International Panel on Climate Change or similar sources to produce water supply time series. In addition, development is underway for an adjustment procedure for the ensemble forecasts to remove forecast biases.

The NWS is actively seeking to collaborate with both new and existing forecast users to improve the forecast services that address user needs. A feedback form can be filled out online at: http://www.weather.gov/survey/nws-survey.php?code=WR_WSP. Alternatively, users may email Kevin Werner at kevin.werner@noaa.gov.

Kevin Werner is the Service Coordination Hydrologist at the Colorado Basin River Forecast Center of the National Weather Service in Salt Lake City, Utah.

Fire potential prediction

By Gregg Garfin

The fifth annual National Seasonal Assessment Workshop for the Eastern and Southern United States was held on January 29–30, 2008, in Shepherdstown, West Virginia. The workshop, a collaboration between the National Interagency Coordination Center (NICC), CLIMAS, and the Program for Climate, Ecosystem and Fire Applications at the Desert Research Institute (CEFA), brings together fire behavior analysts, fuels specialists, fire meteorologists, and climatologists to assess and anticipate the potential need for firefighting resources for the upcoming fire season. This year's workshop focused on fire potential east of the Rocky Mountains. A similar workshop focusing on the western states and Alaska will be held this spring in Boulder, Colorado, but a pre-season overview of fire potential in the Southwest is included here.

The 2008 eastern and southern assessment generated during the workshop predicts above-normal fire potential for most of Florida, parts of Georgia and the Carolinas, and the Eastern Seaboard. Central Texas and Oklahoma are also primed for fire this winter and spring due to the high abundance of grass and fine fuels and dry conditions that are predicted to last through the spring. Primary fire season in the Southeast runs from December through June; for the Northeast, the time period between spring snow melt and summer thunderstorms comprises one of two major fire seasons; the other occurs during autumn. As with the Southwest, the fire season for the south-central Plains, including central Texas, can start as early as January, especially if grasses are cured and January weather is warm, dry, and windy.

The pre-season outlook for the Southwest, based on preliminary information from fire experts at the Southwest Coordination Center (SWCC), suggests above-normal fire potential for West Texas and the eastern quarter of New Mexico. This region of high fire potential is characterized by abundant herbaceous fuels, dry conditions this winter, and a tendency for desiccating downslope winds—those on the lee side of the Continental Divide—to occur during the transition from winter to spring. For March through May, this region of above-normal potential is expected to spread across southwest New Mexico as fuels dry during the windy spring months. Normal fire potential is expected elsewhere in the region; herbaceous fuels in areas above 7,000 feet have been compacted by winter snow, presenting a lower risk of fire spread during the spring months.

Preliminary information from fire experts also suggests that above-normal fire potential for June and July will increase across southeastern Arizona and southwestern New Mexico for about four to six weeks before monsoon onset. During this time period, potential is expected to decrease across West Texas and eastern New Mexico as seasonal precipitation kicks in. The greatest uncertainties in the forecast are due to short-term weather patterns, such as hot, dry conditions during May that may increase curing of fine fuels, or periodic storms, which would decrease fire potential in grass-dominated areas.

For more information about national seasonal and monthly fire potential outlooks, visit: http://www.nifc.gov/nicc/predictive/outlooks/outlooks.htm.

For specific information about the Southwest, visit: http://gacc.nifc.gov/swcc/predictive/outlooks/outlooks.htm.

Temperature (through 2/20/08)

Source: High Plains Regional Climate Center

Temperatures are averaging between 45 and 65 degrees Fahrenheit in the lower deserts of Arizona and 45 to 55 in the southern parts of New Mexico since the start of the water year on October 1 (Figure 1a). The higher elevations in both states are averaging 35–45 degrees F, with the highest passes in north central New Mexico averaging 20–30 degrees F. With a few exceptions, these temperatures are ranging from 0–4 degrees F above average for the water year across most areas of both states (Figure 1b). In the past thirty days, a series of cold winter storms have moved through most parts of Arizona and the northwestern half of New Mexico, dropping temperatures 0–4 degrees F below average (Figures 1c–d). The southeastern third of New Mexico missed out on the storms, and temperatures remain 0–4 degrees F above average.

The cooler temperatures of mid-December through mid-February have not balanced out the extremely high temperatures that occurred in October and November. Only a few high elevation areas of northern New Mexico and western-central Arizona have temperatures below average. The winter storms are still moving southwest to northeast across Arizona and northwestern New Mexico, leaving central and eastern New Mexico warm and relatively dry. In fact, the only part of the southwestern U.S. that is receiving the warm and dry conditions forecast by the Climate Prediction Center for this La Niña is southeastern New Mexico.

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 '07–'08 (through February 20, 2008) average temperature.

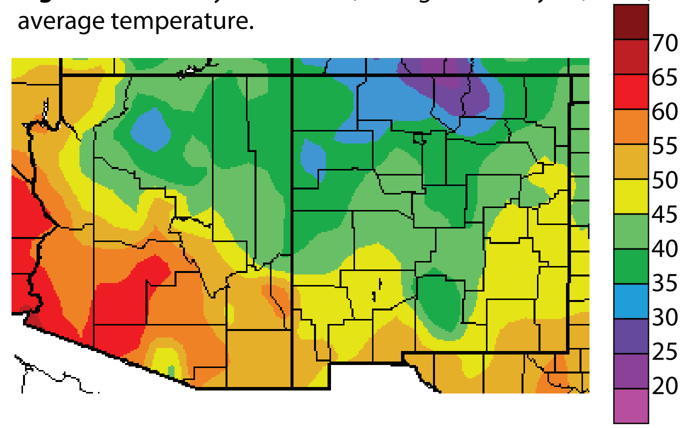


Figure 1b. Water year '07–'08 (through February 20, 2008) departure from average temperature.

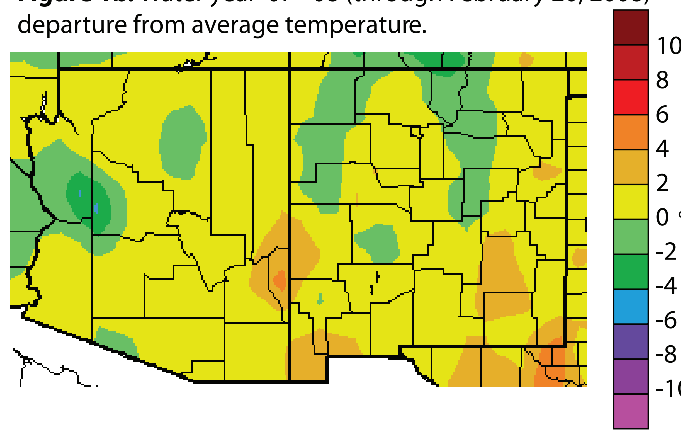


Figure 1c. Previous 30 days (January 22–February 20, 2008) departure from average temperature (interpolated).

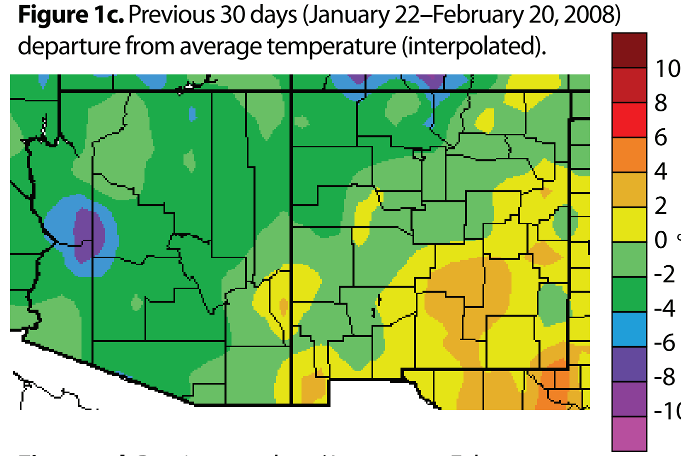
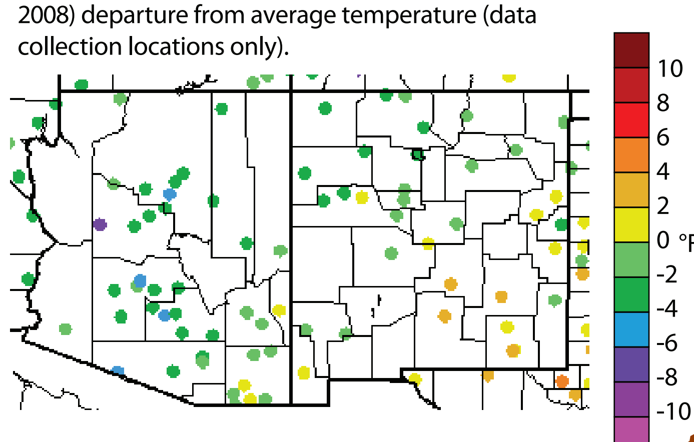


Figure 1d. Previous 30 days (January 22–February 20, 2008) departure from average temperature (data collection locations only).



Precipitation (through 2/20/08)

Source: High Plains Regional Climate Center

For the water year, most of western and central Arizona, the New Mexico-Arizona border, and north-central New Mexico have received 110–200 percent of average precipitation (Figures 2a–b). The southeastern two-thirds of New Mexico generally have received between 5 and 90 percent of average precipitation, which is typical of a La Niña year. The storm tracks from the southwest to the northeast have dropped significant precipitation in central Arizona along the windward face of the Mogollon Rim, leaving the top of the Colorado Plateau slightly below average for the water year. The more recent storms have been cold enough to drop precipitation on top of the plateau, improving the short-term drought conditions. Even if temperatures rise and conditions dry out, run-off from the current snowpack should be above average. In the past thirty days, precipitation has been 130–300 percent of average across much of Arizona and the northwestern third of New Mexico (Figures 2c–d). Only southeastern New Mexico and the southeast corner of Arizona have had less-than-average precipitation. The southeast corner of New Mexico has received less than 25 percent of average precipitation in the past thirty days. All the precipitation in the past month has resulted from four winter storms moving across in the same track, which is most unusual for a La Niña pattern.

Notes:

The water year begins on October 1 and ends on September 30 of the following year. As of October 1, 2007, we are in the 2008 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 '07–'08 (through February 20, 2008) percent of average precipitation (interpolated).

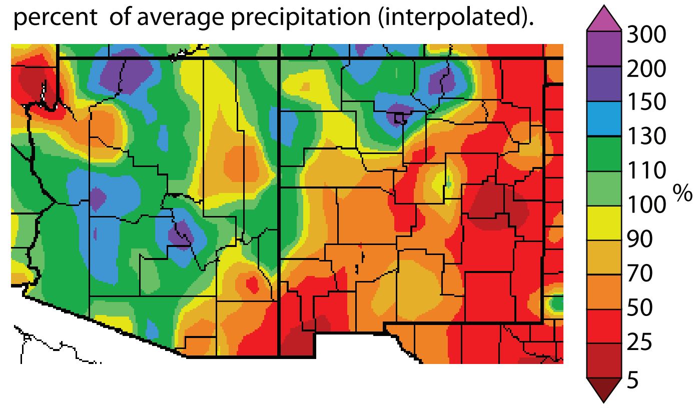


Figure 2b. Water year '07–'08 (through February 20, 2008) percent of average precipitation (data collection locations only).

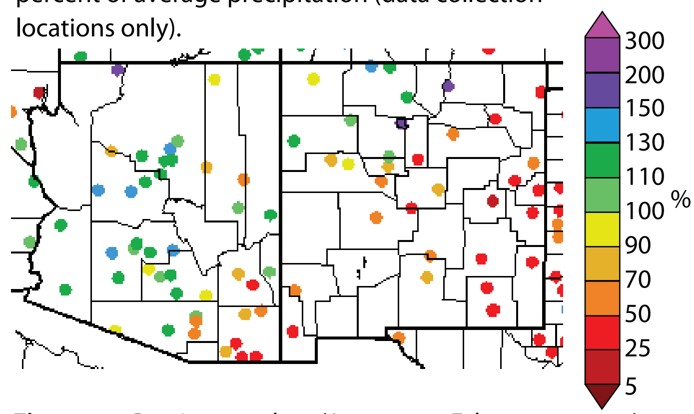


Figure 2c. Previous 30 days (January 22–February 20, 2008) percent of average precipitation (interpolated).

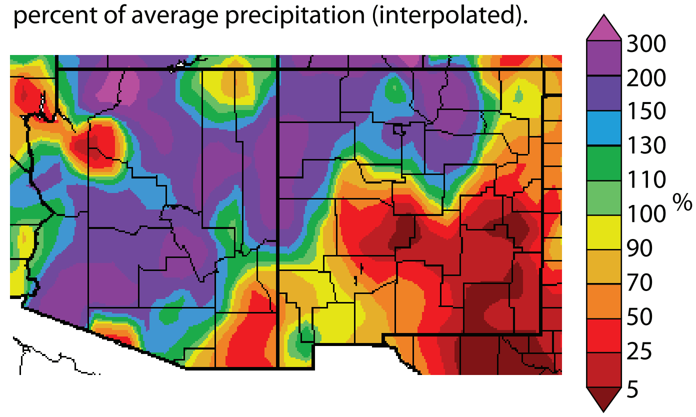
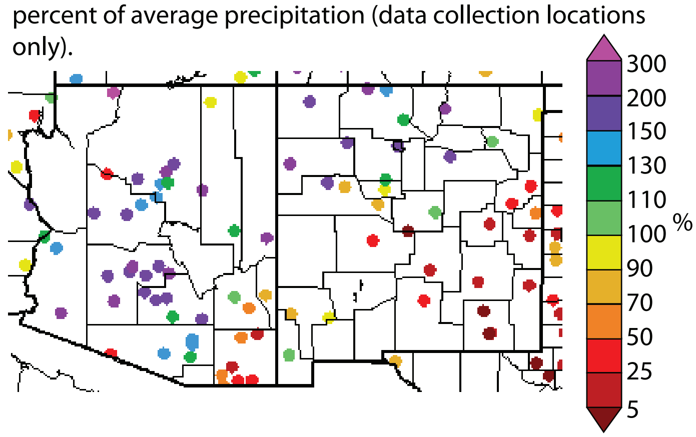


Figure 2d. Previous 30 days (January 22–February 20, 2008) percent of average precipitation (data collection locations only).



U.S. Drought Monitor
(released 2/21/08)

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

Drought conditions persist in parts of Arizona, but the extent and intensity of the drought decreased over the northern and western portions of the state due to recent above-average precipitation (Figure 3). The percentage of area under some level of drought in Arizona is down to 40 percent, less than half of what it was in November 2007. Only a slim area along the border with California remains under severe drought, while western and southwestern Arizona still face moderate drought conditions.

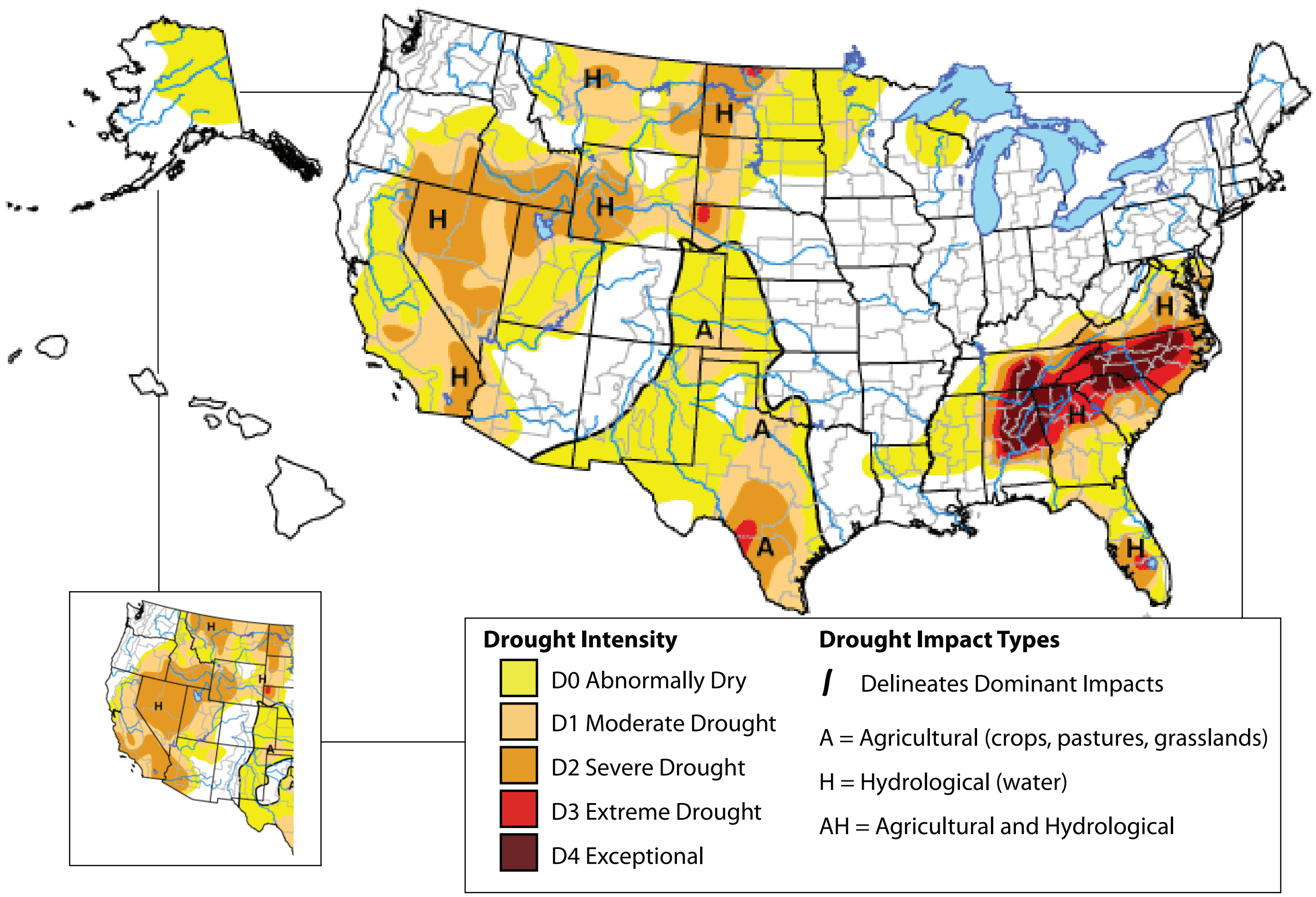
Since last month, abnormally dry conditions have expanded across southwestern New Mexico and southeastern Arizona. Approximately 60 percent of New Mexico is currently experiencing drought conditions, nearly double the area that was experiencing drought three months ago.

In water-related news, the New Mexico state legislature has requested more than $1 million to complete hydrogeologic mapping of the Sacramento Mountains. Preliminary data from the mapping project, which includes monitoring forty-five wells and thirteen springs, indicate that thinning the forest back to historical densities will increase water supply and improve wildlife habitat (*Alamogordo Daily News*, February 12).

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 Brad Rippey, USDA.

Figure 3. Drought Monitor released February 21, 2008 (full size) and January 17, 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
(through 12/31/07)

Source: Arizona Department of Water Resources

Short-term drought conditions improved markedly across Arizona from December to January, according to the recent update of the Arizona Drought Monitor Report (Figure 4a). Exceptionally wet weather through December and January helped boost soil moisture, snowpack, and streamflow across much of the state, improving short-term drought conditions that persisted through the warm and dry fall of 2007. Most watersheds across the state moved from moderate to abnormally dry drought status, with seven watersheds now drought free. Abnormally dry conditions are lingering from the fall season in much of northwest Arizona and the Santa Cruz and San Pedro River watersheds in the southern part of the state. These areas will most likely continue to improve with recent precipitation in February that is not included in this report. Long-term drought conditions still persist across Arizona due to long-term precipitation deficits (Figure 4b). All watersheds are experiencing some level of long-term drought based on long-term (12–48 month) precipitation and streamflow observations.

The recent wet conditions will help improve water supplies across Arizona, but the drought isn't over, according to a recent report on ABC15.com, a Phoenix, Arizona, television station news website. Dramatic changes in the levels of Lake Mead and Lake Powell have occurred over the past twenty-five years. Tony Haffer with the National Weather Service in Phoenix said that Lake Mead was at full capacity in 1983 and is near half capacity now due to persistent drought conditions in recent years. It will take a number of wet years to replenish reservoirs and water supplies, Haffer said.

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

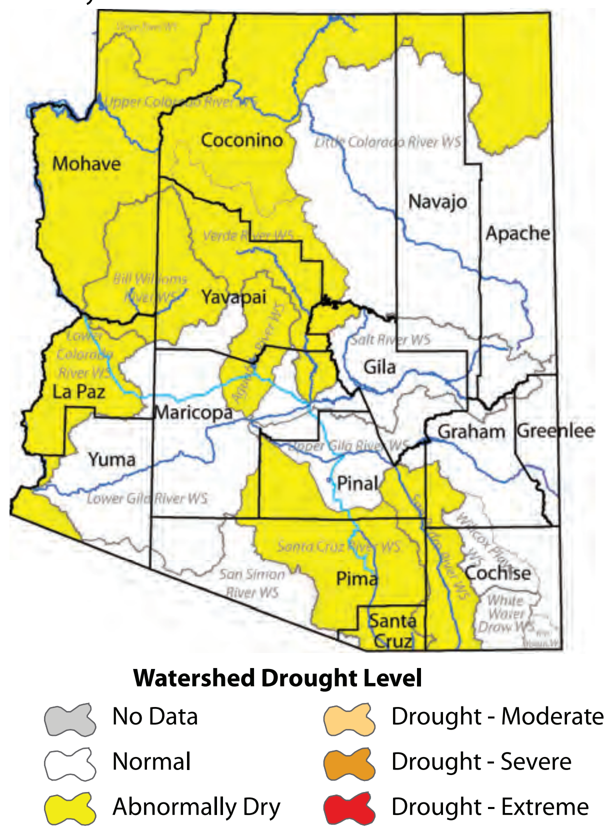
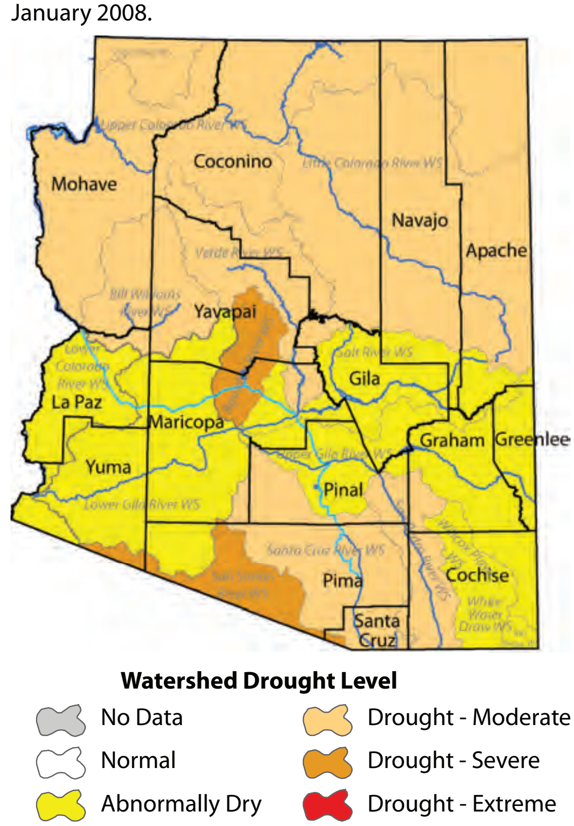


Figure 4b. Arizona long-term drought status for January 2008.



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

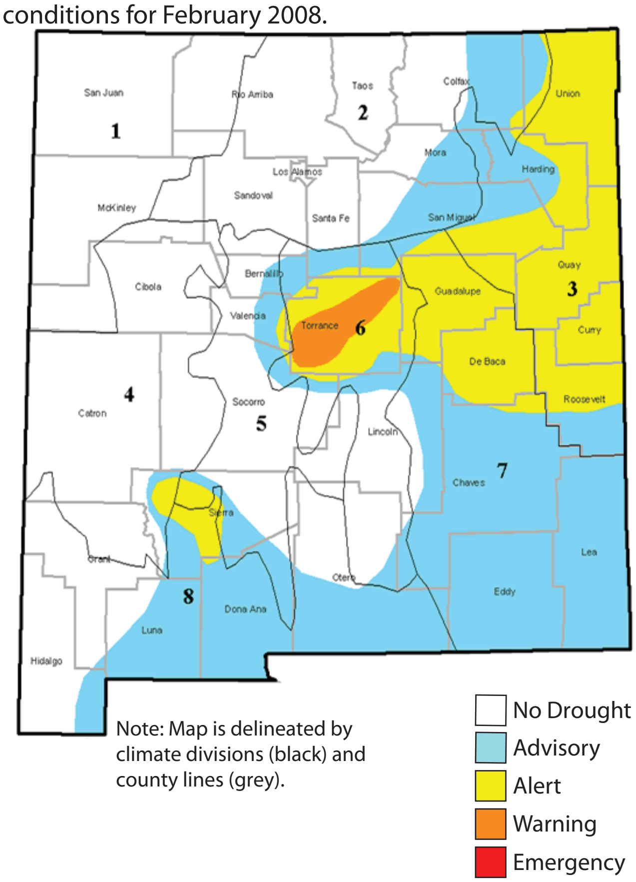
(through 1/31/08)

Source: New Mexico State Drought Monitoring Committee

The February 2008 New Mexico Drought Status map shows lingering moderate drought in parts of Torrance County, as previously depicted on the December Drought Status map. Advisory drought conditions have expanded to the south and southwest as a result of well below-average precipitation during December, January, and early February in the southeastern half of the state. Many sites in the area extending from the east central and southeast plains to the southwest boot heel received little or no precipitation (see Figures 2a–b). Conditions in the northwest and north central parts of the state have been just the opposite. Since the end of November, moisture-laden storm systems have repeatedly moved through the area, ameliorating fall 2007 La Niña drying effects in this part of the state. As of early February 2008, snow pack in northern New Mexico was the best it has been since 1997.

In water-related news, the New Mexico American Water Company is adding new wells to address growth in the Clovis area (*Clovis News Journal*, February 6). The city is expected to experience growth from the transition of Cannon Air Force Base to a Special Operations Command and from new industries. Some of the company's wells, connected to the Ogallala Aquifer, are down to their last forty feet of standing water; water levels have dropped to about nine feet in the last three years, according to a company spokesman. The rate of the decline in water levels has some officials concerned, because experts say the Ogallala Aquifer could run out of sustainable water within the next forty years. In the face of declining water levels, Clovis officials noted the need for projects to conserve water.

Figure 5. Short-term drought map based on meteorological conditions for February 2008.



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 1/31/08)

Source: National Water and Climate Center

Storage increased substantially in reservoirs within Arizona's borders (Figure 6). Storage in the Salt and Verde river reservoirs increased by more than 500,000 acre-feet during the last month; current levels in these reservoirs are well above last year's levels. Storage in San Carlos Reservoir also increased. Storage in Lakes Powell and Mead declined and is expected to continue declining until the spring 2008 snowmelt runoff season, when current forecasts anticipate slightly above-average inflow to Lake Powell (see Figure 8).

Ongoing concerns about the impact of groundwater pumping near the headwaters of the Verde River intensified after the Salt River Project (SRP) said in a letter that Yavapai County towns, including Prescott, at most have rights to only a fraction of the water they plan to pump from the Big Chino subbasin (*The Daily Courier*, February 16). SRP officials are concerned about pumping because the Big Chino supplies about 80 percent of the baseflow in the first 24 miles of the Verde.

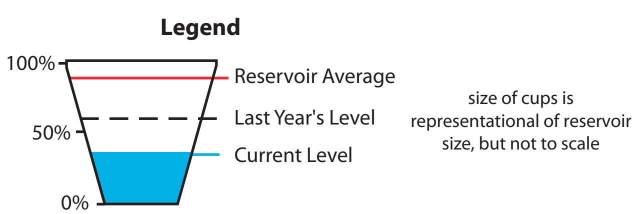
Notes:

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.

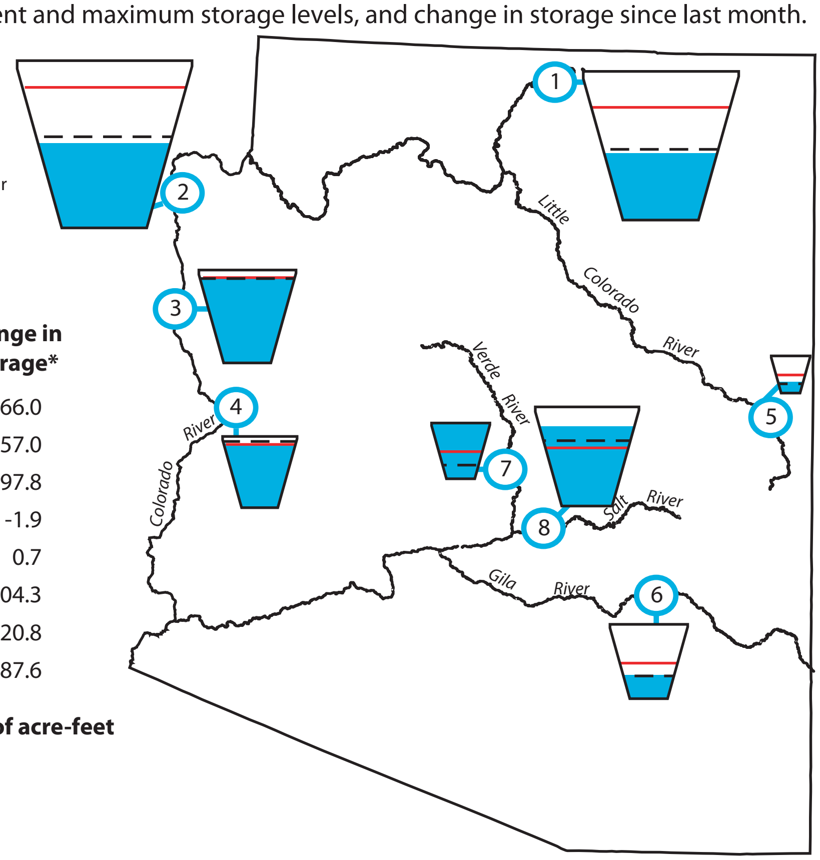
These data are based on reservoir reports updated monthly by the National Water and Climate Center of the U.S. Department of Agriculture's Natural Resource Conservation Service (NRCS). For additional information, contact Larry Martinez, NRCS, Larry.Martinez@az.usda.gov.

Figure 6. Arizona reservoir levels for January 2008 as a percent of capacity. The map also depicts the average level and last year's storage for each reservoir. The table also lists current and maximum storage levels, and change in storage since last month.



Reservoir Name	Capacity Level	Current Storage*	Max Storage*	Change in Storage*
1. Lake Powell	45%	10,880.0	24,322.0	-366.0
2. Lake Mead	50%	13,017.0	26,159.0	157.0
3. Lake Mohave	92%	1,662.8	1,810.0	97.8
4. Lake Havasu	90%	555.0	619.0	-1.9
5. Lyman Reservoir	30%	9.0	30.0	0.7
6. San Carlos	32%	282.1	875.0	104.3
7. Verde River System	98%	282.5	287.4	120.8
8. Salt River System	80%	1,615.3	2,025.8	387.6

*** thousands of acre-feet**



On the Web:

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

New Mexico Reservoir Levels

(through 1/31/08)

Source: National Water and Climate Center

New Mexico statewide reservoir storage increased slightly since last month, with the greatest increase at Elephant Butte reservoir (Figure 7). Compared to last year, storage has decreased in most of the state's reservoirs. Notable storage increases have occurred since last year at El Vado, Heron, Lake Avalon, and Costilla reservoirs.

In water-related news, following New Mexico's relinquishment of water to Texas, the Elephant Butte Irrigation District's board of directors approved an additional six acre-inches of water per acre to start off the 2008 irrigation season (Associated Press, February 15); the total allotment will be eighteen acre-inches per acre. Under the 1939 Rio Grande Compact, the Elephant Butte district is considered part of Texas. At 326,000 gallons, an acre-foot is enough water to meet the needs of two households for one year.

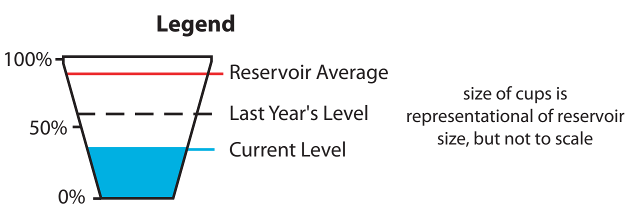
Notes:

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.

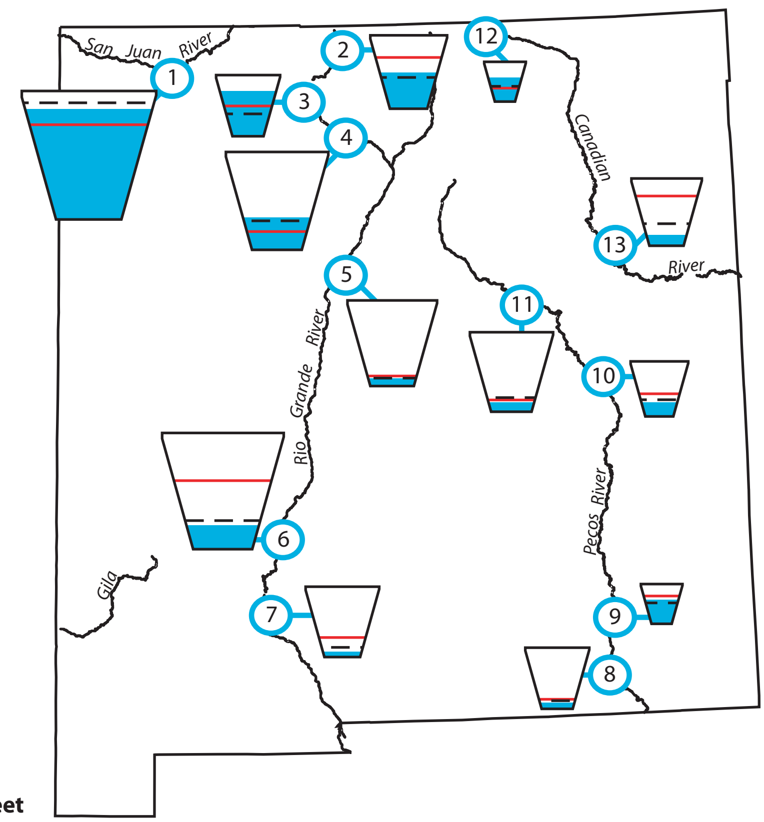
These data are based on reservoir reports updated monthly by the National Water and Climate Center of the U.S. Department of Agriculture's Natural Resource Conservation Service (NRCS). For additional information, contact Larry Martinez, NRCS, Larry.Martinez@az.usda.gov.

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



Reservoir Name	Capacity Level	Current Storage*	Max Storage*	Change in Storage*
1. Navajo	86%	1,456.4	1,696.0	-22.6
2. Heron	49%	195.3	400.0	0.1
3. El Vado	73%	142.2	195.0	0.0
4. Abiquiu	33%	182.8	554.5	2.3
5. Cochiti	10%	50.2	491.0	0.1
6. Elephant Butte	21%	453.7	2,195.0	44.9
7. Caballo	8%	25.8	332.0	1.8
8. Brantley	10%	14.4	147.5	-4.1
9. Lake Avalon	60%	2.4	4.0	0.9
10. Sumner	26%	26.8	102.0	-1.0
11. Santa Rosa	12%	50.6	438.3	0.3
12. Costilla	61%	9.8	16.0	0.5
13. Conchas	16%	40.2	254.2	0.7

*** thousands of acre-feet**



On the Web:

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

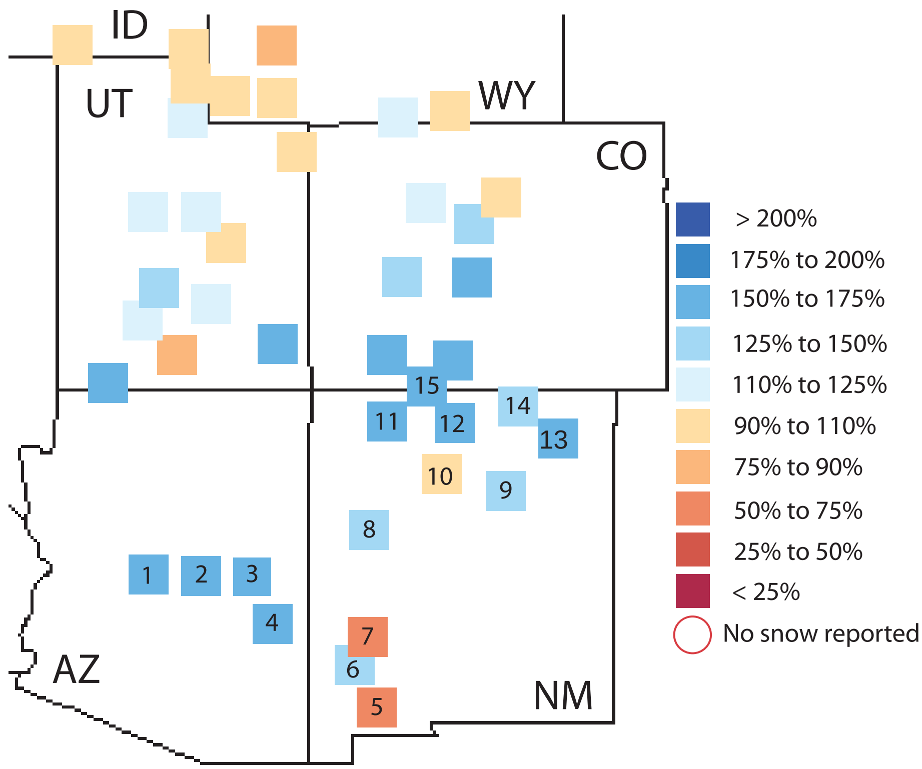
Southwest Snowpack

(updated 2/20/08)

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

Snowpack observations at thirteen of fifteen sites in Arizona and New Mexico are either greater or approximately the same as those reported in January (Figure 8). Only two sites in southwest New Mexico, the Gila and Mimbres river basins, are reporting decreases since last month, dropping from 75–90 percent of average to 50–75 percent. All sites in Arizona have reported improvements in percent of average Snow Water Content (SWC) since last month. The Cimarron and San Miguel, Dolores, Animas, and San Juan river basins increased from 125–150 percent to 150–175 percent since last month. Sites in northern New Mexico are mixed, with six of eight sites maintaining about the same percent of average SWC as was reported in January. Barring a change in the regional weather pattern of recent weeks, SWC spring estimates in Arizona and New Mexico provide evidence the region may experience normal and possibly above-average streamflow conditions this spring.

Figure 8. Average snow water content (SWC) in percent of average for available monitoring sites as of February 20, 2008.



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

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

Notes:

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

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

On the Web:

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

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

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

Temperature Outlook

(March–August 2008)

Source: NOAA Climate Prediction Center (CPC)

Forecasts for the Southwest are predicting increased chances of above-average temperatures through August 2008 (Figures 9a–d). The chance of above-average temperatures in the region exceeds 40 percent relative to average or below-average temperatures in each month. These forecasts for above-average temperatures encompass all of Arizona and New Mexico for the March–May 2008 period, but shift with the highest probabilities centered on Arizona by the April–June period. These forecasts are based on past temperature patterns associated with La Niña events and the expectation that long-term trends in above-average temperatures will persist through the spring.

Notes:

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

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

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

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

Figure 9a. Long-lead national temperature forecast for March–May 2008.

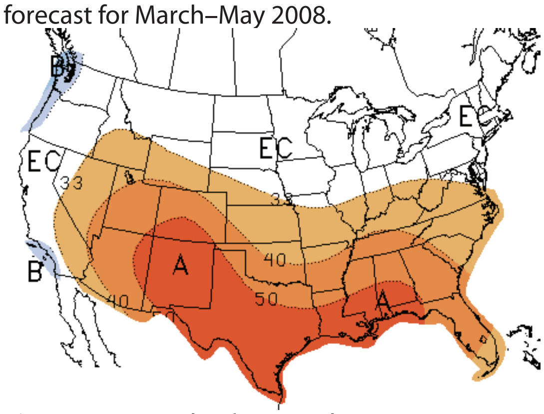
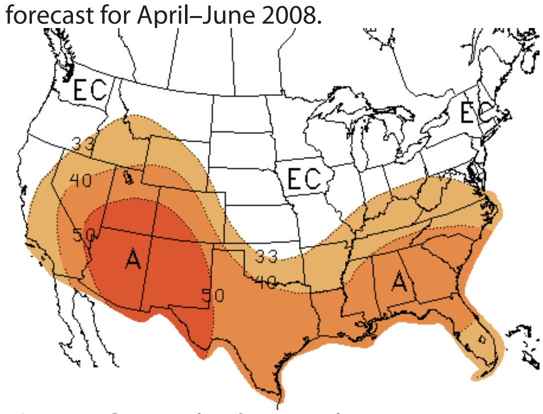


Figure 9b. Long-lead national temperature forecast for April–June 2008.



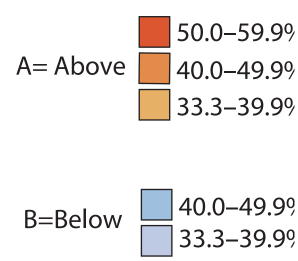


Figure 9c. Long-lead national temperature forecast for May–July 2008.

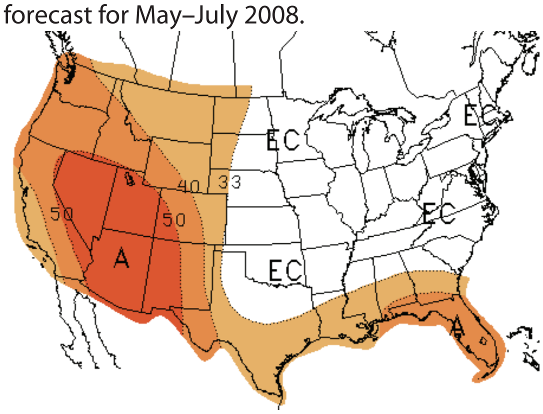
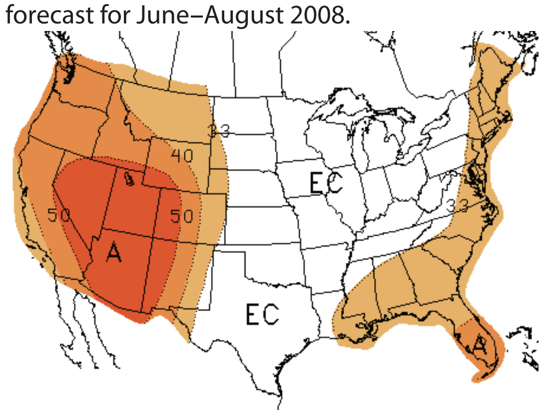


Figure 9d. Long-lead national temperature forecast for June–August 2008.



EC= Equal chances. No forecasted anomalies.

On the Web:

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

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

Precipitation Outlook

(March–August 2008)

Source: NOAA Climate Prediction Center (CPC)

Seasonal forecasts call for increased chances of below-average precipitation through the spring for all of Arizona and New Mexico (Figure 10a–b). A greater than 33 percent chance of below-average precipitation (relative to average or above-average precipitation occurring) is forecasted across the Southwest for the March–May and April–June periods. The chances for below-average precipitation are even higher (greater than 40 percent) across most of Arizona for the March–May period and across much of central and southern New Mexico for April–June. These forecasts are based on the expectation that the current moderate-strength La Niña event will persist through the spring and bring typical La Niña impacts, including below-average precipitation, to the southwestern United States. The forecast for below-average precipitation shifts northward by the May–July period due to decreasing La Niña impacts and increased forecast uncertainty (Figure 10c–d).

Notes:

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

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

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

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

Figure 10a. Long-lead national precipitation forecast for March–May 2008.

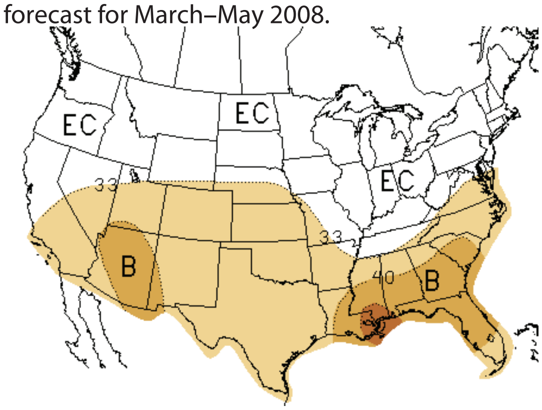
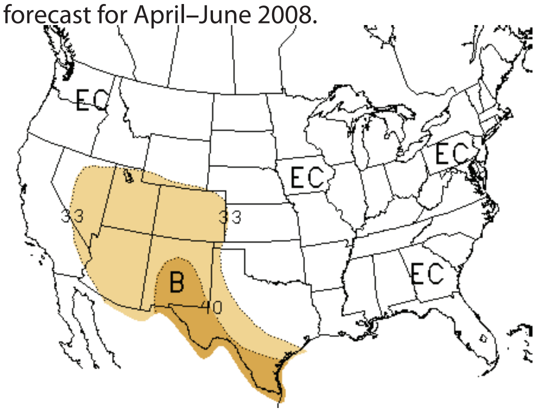


Figure 10b. Long-lead national precipitation forecast for April–June 2008.



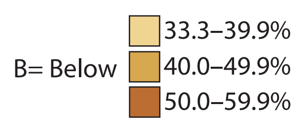


Figure 10c. Long-lead national precipitation forecast for May–July 2008.

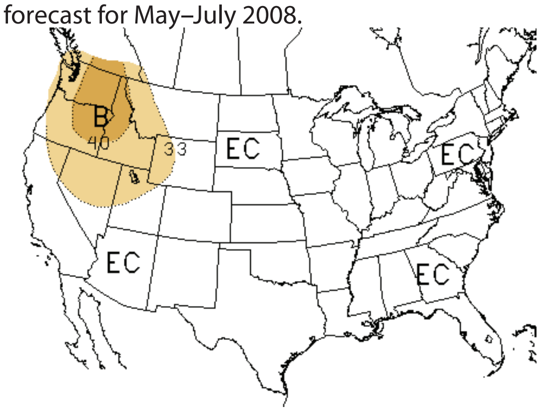
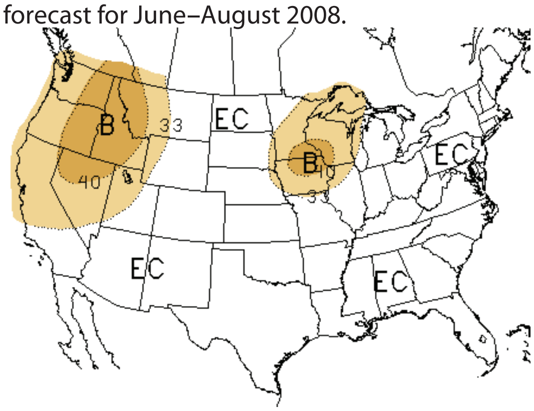


Figure 10d. Long-lead national precipitation forecast for June–August 2008.



EC= Equal chances. No forecasted anomalies.

On the Web:

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

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

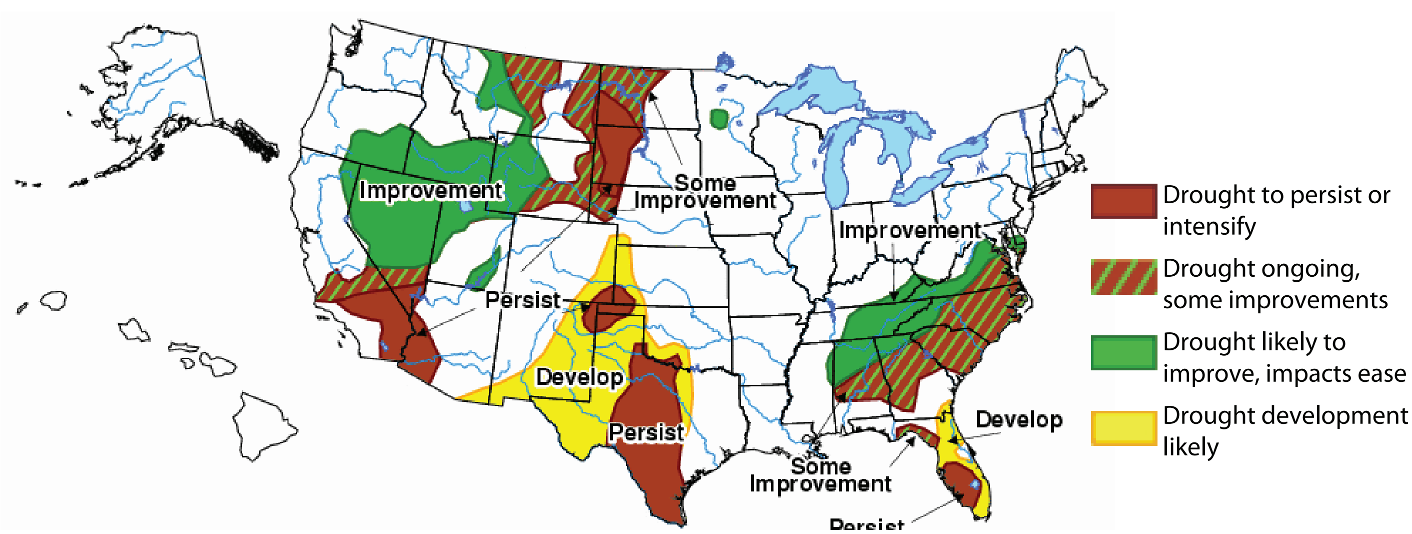
Seasonal Drought Outlook
(through May 2008)

Source: NOAA Climate Prediction Center (CPC)

The latest NOAA Seasonal Drought Outlook predicts that drought will improve across portions of the Great Basin and northern Rockies while much of New Mexico and eastern Texas will see drought conditions develop (Figure 11). Much of Florida is also expected to see drought conditions develop over the coming months, while some improvements are expected in the remainder of the Southeast. The forecast is based on precipitation and temperature patterns typical during moderate to strong La Niña events like the 2007–08 event currently underway. La Niña events typically bring below-average precipitation to the southern tier states from Arizona to Florida. This is reflected in the Seasonal Drought Outlook where drought conditions are expected to persist in western Arizona, Texas, and Florida, and develop across much of New Mexico and eastern Texas. Seasonal precipitation forecasts depict an increased chance of below-average precipitation across this region through the remainder of the winter into the spring season.

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

Figure 11. Seasonal drought outlook through May 2008 (released February 21, 2008).

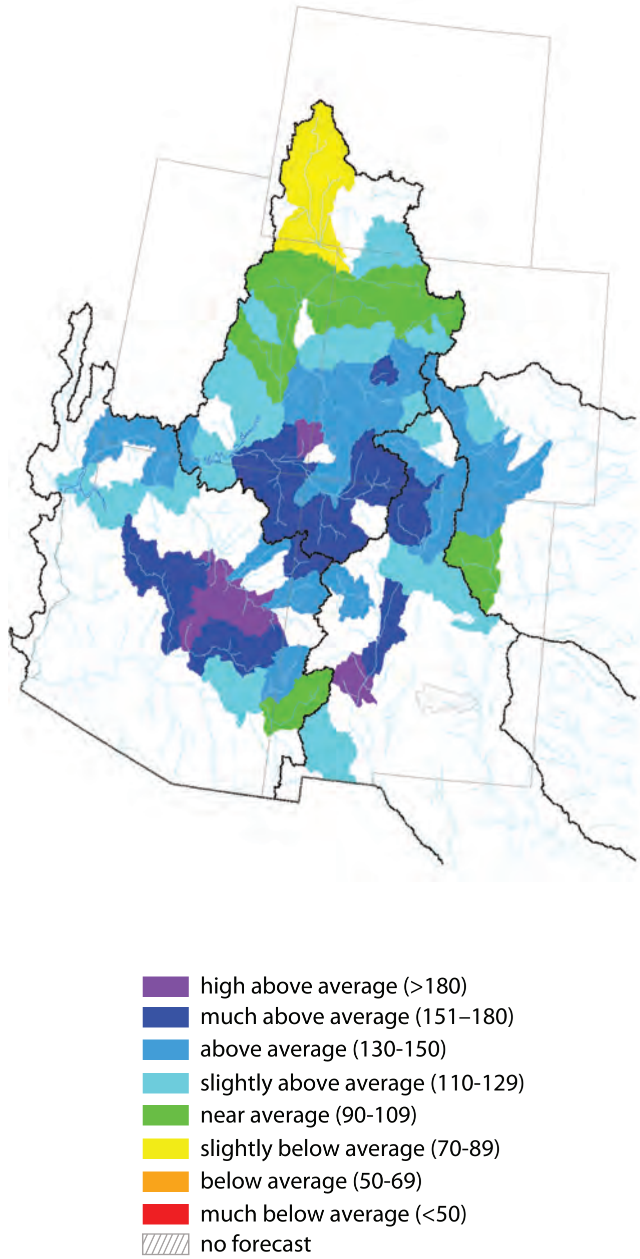


On the Web:
For more information, visit:
http://www.drought.noaa.gov/

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

The forecasted percent of average streamflow has increased for most basins in Arizona and New Mexico since last month. This is due largely to continued above-average precipitation and snowpack in most of the region's basins. Currently, all but two basins with forecasts in Arizona and New Mexico are expected to have slightly above- to high above-average flows (Figure 12). For the Colorado River, only the upper reaches of the basin in Wyoming are forecasted to experience slightly below-average flows. Reservoir storage remains above average in the Salt and Verde River systems, and water users in Arizona can expect well above-average surface water supplies this spring unless current weather patterns change. Average statewide basin snowpack in Arizona was at 145 percent of average as of February 15. In northern New Mexico, several snow telemetry (SNOTEL) sites have reported above 200 percent of average snowpack in the first half of February. Streamflow forecasts for the Rio Grande Basin range from an average of 111 percent for the Jemez River below Jemez Canyon Dam to 183 percent of average for the Rio Grande at San Marcial. Average snowpack in the Rio Grande Basin was at 147 percent as of February 1.

Figure 12. Spring and summer streamflow forecast as of February 1, 2008 (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)

The present La Niña event has continued to strengthen this past month with sea surface temperatures (SSTs) falling to over two degrees celsius below-average across the central Pacific Ocean. The International Research Institute for Climate and Society (IRI) notes that winds are diverging away from the cold pool in the central Pacific, helping to pull up deep cold water and sustain the strength of the current La Niña episode. Southern Oscillation Index (SOI) values continued to fall this month with a January value of -1.9, indicating strong connections between the La Niña SST pattern and atmospheric circulation patterns across the Pacific Ocean (Figure 13a). The NOAA Climate Prediction Center (CPC) has also noted that the current oceanic and atmospheric patterns of SSTs and areas of convection are very similar to the last strong La Niña event that occurred between 1998 and 2000.

El Nino-Southern Oscillation (ENSO) forecasts produced by IRI and CPC both continue to indicate a high likelihood of moderate to strong La Niña conditions persisting through the remainder of the winter season into the early spring.

Notes:

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

The IRI probabilistic ENSO forecast indicates a 95 percent chance of La Niña conditions persisting through the February–April period and a 70 percent chance through the April–June period (Figure 13b). Neutral conditions are expected to return by the upcoming summer season with diminishing La Niña impacts through the spring. Seasonal forecasts through the early spring continue to paint a dry picture across the Southwest based on typical precipitation patterns associated with strong cold events like the current 2007–08 La Niña. Unusual wet conditions across Arizona may come to an end with a return to dry weather if more typical La Niña teleconnections return this spring.

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

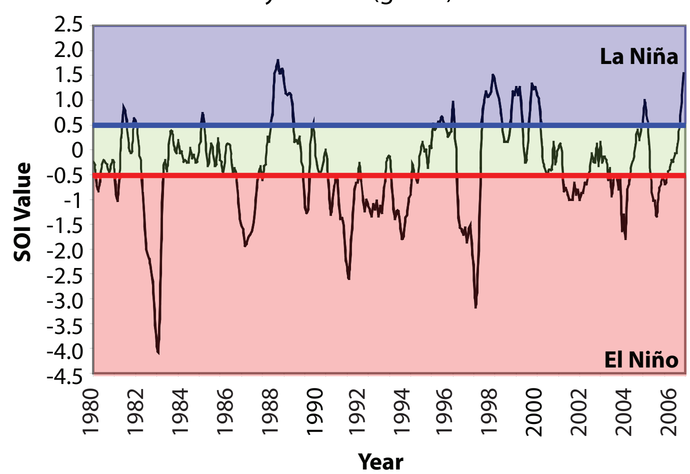
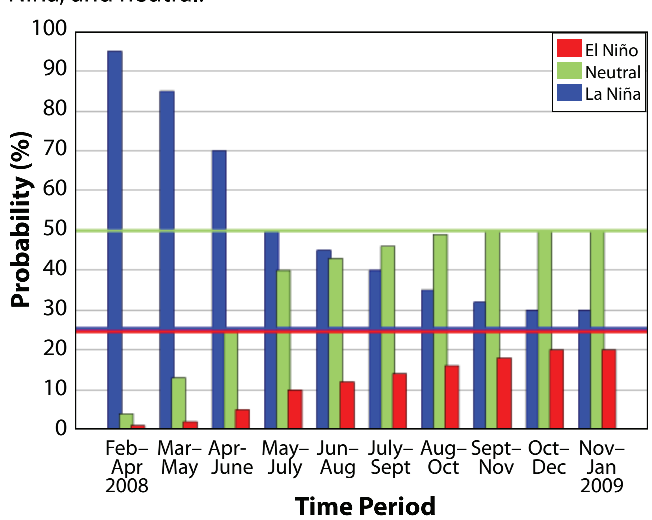


Figure 13b. IRI probabilistic ENSO forecast for El Niño 3.4 monitoring region (released February 21, 2008). Colored lines represent average historical probability of El Niño, La Niña, and neutral.



Temperature Verification
(November 2007–January 2008)
Source: NOAA Climate Prediction Center (CPC)

The NOAA-CPC seasonal temperature outlook for November 2007–January 2008 predicted increased chances of above-average temperatures for most of the United States, including probabilities of above-average precipitation (greater than 50 percent) throughout the Southwest (Figure 14a). These predictions were based on a combination of long-term trends and expected effects associated with a strengthening La Niña episode in the Pacific Ocean. Temperatures generally followed this pattern with slightly above-average observations across much of the southern-third and eastern portions of the U.S. (Figure 14b). In contrast to the above-average seasonal temperature predictions, the central Rocky Mountains and Great Basin desert in Nevada observed below-average temperatures due to many cold and wet storm systems crossing the region over the past several months.

Figure 14a. Long-lead U.S. temperature forecast for November 2007–January 2008 (issued October 2007).

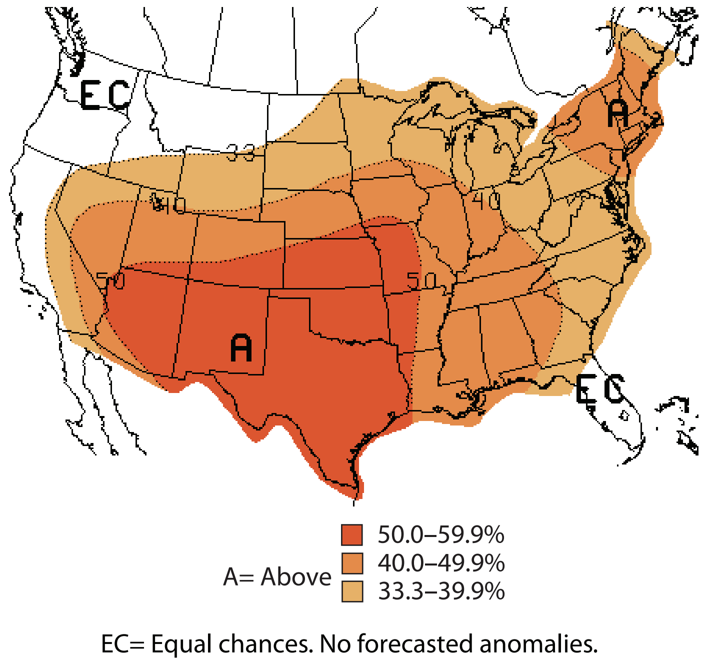
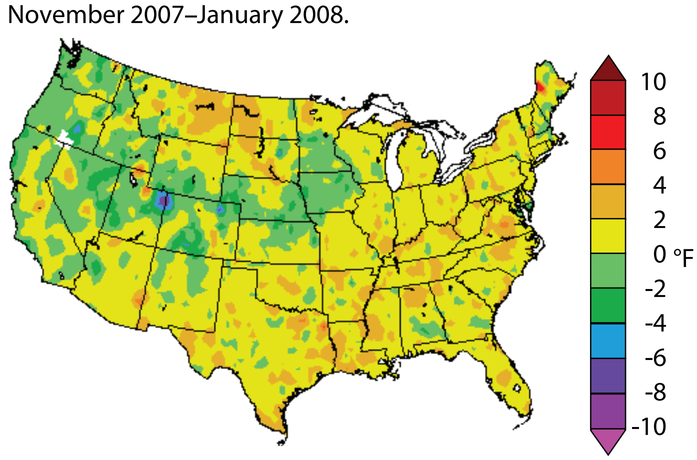


Figure 14b. Average temperature departure (in degrees F) for November 2007–January 2008.



Notes:
Figure 14a shows the NOAA Climate Prediction Center (CPC) temperature outlook for the months November 2007–January 2008. This forecast was made in October 2007.

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

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

Figure 14b shows the observed departure of temperature (degrees F) from the average for the November 2007–January 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.

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

Precipitation Verification

(November 2007–January 2008)

Source: NOAA Climate Prediction Center (CPC)

The NOAA-CPC seasonal precipitation outlook for November 2007–January 2008 predicted increased probabilities of below-average precipitation in the Southwest and central and southern Great Plains and increased probabilities of above-average precipitation for the Pacific Northwest and Northern Rockies (Figure 15a). The overall spatial pattern of observed precipitation was notably incorrect with respect to the outlook for the Southwest (Figure 15b). Much of Arizona received precipitation that was greater than 130 percent of normal. However, most of New Mexico, with the exception of the northwest corner of the state, received precipitation that was average to slightly below-average. Although unusual for moderate La Niña events, a storm track has persisted through this winter, bringing multiple wet and cold storms through Arizona. In contrast with the seasonal precipitation forecasts, this persistent jet stream pattern also has left parts of the northwest United States with below-average precipitation. Dry conditions expected with La Niña events have developed across southern states from New Mexico to Florida, as projected in the November–January forecast.

Figure 15a. Long-lead U.S. precipitation forecast for November 2007–January 2008 (issued October 2007).

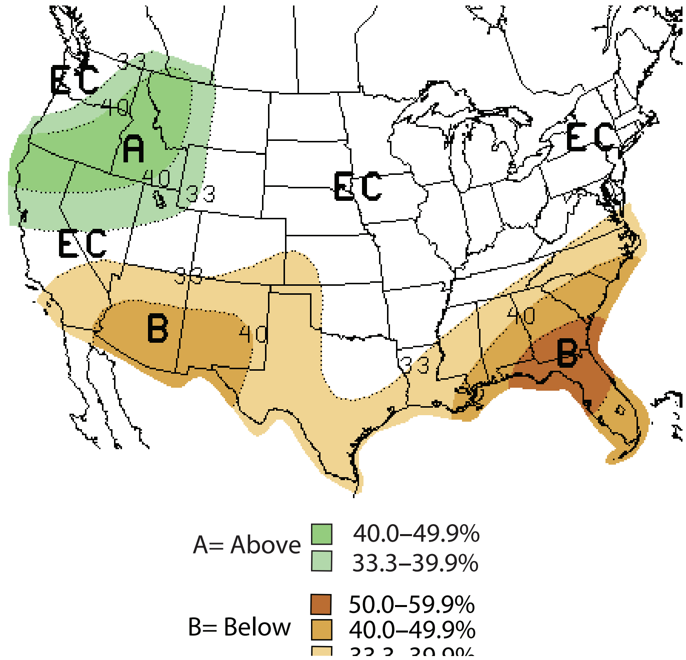
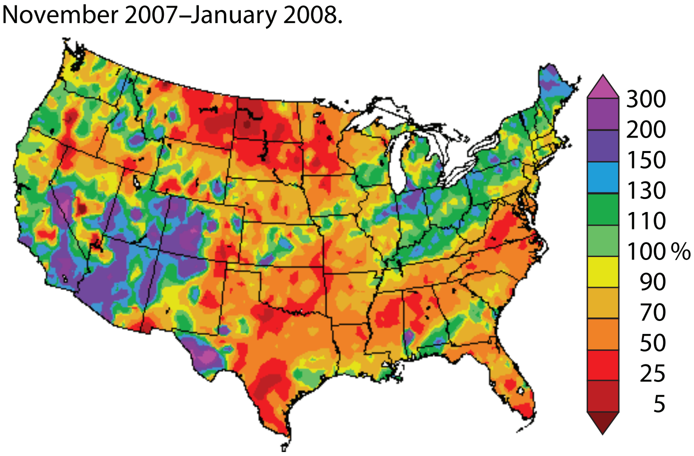


Figure 15b. Percent of average precipitation observed from November 2007–January 2008.



Notes:

Figure 15a shows the NOAA Climate Prediction Center (CPC) precipitation outlook for the months November 2007–January 2008. This forecast was made in October 2007.

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

Figure 15b shows the observed percent of average precipitation for November 2007–January 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