March 24, 2010

Southwest Climate Outlook

Vol. 9 Issue 3

Source: Zack Guido, CLIMAS.

Photo Description: Widespread and heavy snow in the high elevations of Arizona and New Mexico have been the weather story of the year. The region around the North Rim of the Grand Canyon—where this image was taken in February—and many other areas have had above-average snowfall.

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: macaulay@email.arizona.edu

In this issue...

Feature Article page 3

It came in a caravan of white. Since mid-January, a trail of storms crossed the mountains and deserts of the Southwest, leaving the Verde River, Upper Salt River, Upper Gila River basin, and the Little Colorado River basins blanketed in snow...

AZ Drought page 9

The wet weather continued across Arizona this past month bringing additional relief to short-term drought conditions across the state. The March 16 update of the National Drought Monitor depicted normal to abnormally dry conditions...

Snowpack page 13

Snowpack levels remain above average in all river basins across Arizona and New Mexico except the Animas Basin in New Mexico. The snow water equivalent (SWE) in the snowpack in Arizona ranged from 214 to 324 percent of average as of March 18...

CLIMAS Climate Assessment for the Southwest

ARIZONA COOPERATIVE EXTENSION
THE UNIVERSITY OF ARIZONA • COLLEGE OF AGRICULTURE AND LIFE SCIENCES

ARIZONA

OFFICE OF THE STATE CLIMATOLOGIST

NM STATE UNIVERSITY

March Climate Summary

Drought– Drought conditions continued to improve across the Southwest, and most of southern Arizona and New Mexico are either only abnormally dry or drought free.

Temperature– A series of cold fronts in February and March brought cooler conditions to the Southwest.

Precipitation– Most of the Southwest remains much wetter than average with significant snowpack as the strong El Niño circulation continues.

ENSO– Moderate El Niño conditions persisted across the equatorial Pacific Ocean again this month and are expected to continue over the next month or two. The chance of ENSO-neutral conditions returning increases by later this spring.

Climate Forecasts– Historical temperature trends contribute to warm seasonal outlooks—there is more than a 50 percent chance that temperatures during the May–July and July–September periods will be similar to the warmest 10 years of the 1971–2000 record. Precipitation outlooks for the April–June period indicate slightly elevated chances that conditions in northern Arizona and New Mexico will be similar to the wettest 10 years of the 1971–2000 period.

The Bottom Line– El Niño once again helped steer winter storms into Arizona and New Mexico. Profuse snow and rain continued to improve drought conditions, build snowpack, and increase projections of spring streamflows. Snowpack is nearly twice the historic average in many high elevation regions in Arizona and many reservoirs in the state are more than 88 percent full; Roosevelt Lake reached record high levels on March 12. El Niño may continue to bring wet weather, as forecasts suggest the event will likely continue through April. While rain and snow have improved winter vegetation growth, summer growth will need a healthy monsoon season. In other words, short-term drought conditions can come and go rapidly.

New soil moisture Web tool for Arizona

The Colorado River Basin Forecast Center (CBRFC) has developed soil moisture simulations for Arizona that allow users to visualize changes in soil moisture in space and time, among other functions. The new Web prototype plugs an important knowledge gap because moisture in the soil directly influences stream runoff and vegetation growth. Rainwater beating down on the landscape, for example, flushes into rivers more quickly and in greater quantities when soils are saturated. Currently, not all water supply forecasts or ecosystem models incorporate soil moisture, in part because the information is not widely available. The CBRFC is developing this product from its hydrologic models and is working with CLIMAS to broadcast the tool to a broader audience so that it can be applied to practical and innovative uses.

"Users can zoom into their neighborhood and track changes over the season" with the Web tool, said Ed Clark, Senior hydrologist at CBRFC. "Anyone tied to land management may find this information valuable, people such as farmers and fire managers and flood control districts." The new soil moisture tool is still in prototype phase, which offers opportunities for users to help shape the presentation of the information. Access the tool at **www.cbrfc.noaa.gov** and on the left hand menu click "soil moisture" and current conditions.

Table of Contents:

2 March 2010 Climate Summary
3 Feature article: Monitoring snowpack and forecasting streamflows in the Southwest

Recent Conditions
6 Temperature
7 Precipitation
8 U.S. Drought Monitor
9 Arizona Drought Status
10 New Mexico Drought Status
11 Arizona Reservoir Levels
12 New Mexico Reservoir Levels
13 Southwest Snowpack

Forecasts
14 Temperature Outlook
15 Precipitation Outlook
16 Seasonal Drought Outlook
17 Streamflow Forecast
18 El Niño Status and Forecast

Forecast Verification
19 Temperature Verification
20 Precipitation Verification

SWCO Staff:

Mike Crimmins, *UA Extension Specialist*
Stephanie Doster, *Institute of the Environment Associate Editor*
Dan Ferguson, *CLIMAS Program Manager*
Gregg Garfin, *Institute of the Environment Deputy Director of Outreach*
Zack Guido, *CLIMAS Associate Staff Scientist*
Rebecca Macaulay, *Graphic Artist*
Nancy J. Selover, *Arizona State Climatologist*

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 of the Environment, 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.

Monitoring snowpack and forecasting streamflows in the Southwest

By Zack Guido

It came in a caravan of white. Since mid-January, a trail of storms crossed the mountains and deserts of the Southwest, leaving the Verde River, Upper Salt River, Upper Gila River basin, and the Little Colorado River basins blanketed in snow.

The large snowpack bodes well for spring river flows in the Southwest. Forecasts for all major rivers in the upper reaches of their watersheds in Arizona and most upper basins in New Mexico suggest at least a 50 percent chance that spring streamflows will be more than 150 percent of average—good news for reservoirs such as the San Carlos Reservoir, which was nearly empty at the beginning of 2010.

Streamflow forecasting is the principal reason why the Natural Resources Conservation Service (NRCS) monitors nearly 2,000 stations and focal points around the West using automated snow telemetry (SNOTEL) stations and manual measurements. These forecasts are integrated into management to help water managers, for example, decide how much water to dole out to irrigation districts and the amount to release from reservoirs. The importance of the forecasts merits a closer look at how snowpack is measured and monitored and how streamflows are forecasted.

Snow Monitoring

Near the summit of Mormon Mountain outside Flagstaff, Ariz., a large rubber pillow filled with anti-freeze is spread on the bare ground. When snow accumulates, sensors inside the pillow measure the weight and calculate the water content in the snow, often called snow water equivalent, or SWE. A nearby pole supports weather devices that monitor air temperature and solar radiation, among other climate variables, and a rain gauge measures the precipitation.

Seven hundred automated SNOTEL systems like the Mormon Mountain station pepper the high country in the West. Each hour the stations transmit radio waves that bounce off the ionized wake of micro-meteorites, dust-size particles that constantly disintegrate in the upper atmosphere. Several NRCS hubs in the West receive the data, administer quality control, and release the information for public consumption.

In Arizona and New Mexico, about 40 SNOTEL stations have been established where snows often accumulate. Most are situated in remote places at elevations between 8,000 and 9,000 feet. The NRCS installed these stations in Arizona beginning in late 1970s.

"Most stations are located in meadows or open areas and near the crests of ridges separating watersheds," said Dino De Simone, Water Supply Specialist for the NRCS. Sites are often on north aspects; if they were

continued on page 4

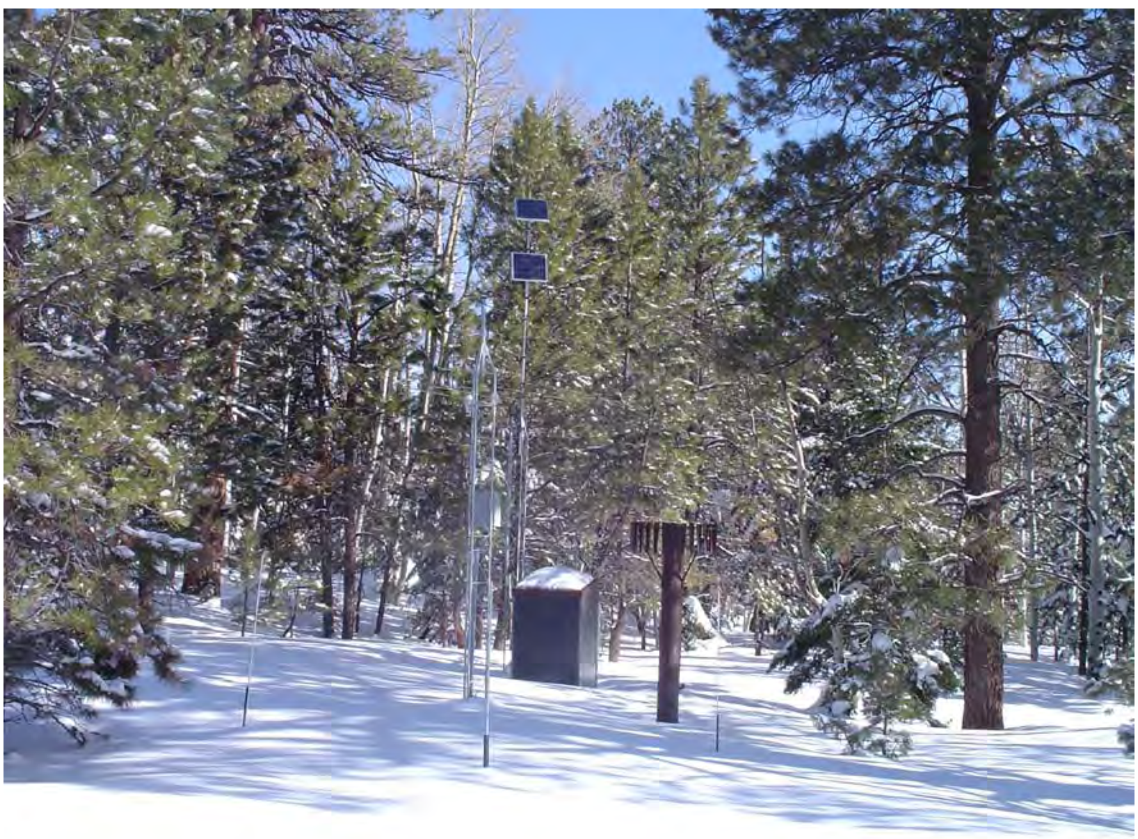


Figure 1. The Beaver Spring SNOTEL site is located in northeastern Arizona near the border with New Mexico. Most SNOTEL and snow course sites are located at high elevations and in clearings where tree canopy does not obstruct precipitation. A typical station contains a rain gauge (the rusty-looking feature in the photograph), solar panels, weather sensors, and a snow pillow (outlined by the three visible poles in the foreground). Photograph courtesy of Dino De Simon, NRCS.

Monitoring snowpack and forecasting streamflows in the Southwest, continued

placed on the southern slopes that receive the brunt of the winter sun they wouldn't be measuring much snow in Arizona.

The value of snow surveys was recognized long before engineers discovered how to reflect radio waves off cosmic dust. In the mid-1930s sites were selected for manual measurements. Surveyors skied or snow-shoed into the remote sites, called snow courses, to collect data about twice a month. Many of these snow courses are still operational today and account for about 60 percent of the 1,950 automated and manual monitoring sites in the West, including Alaska.

Snow course sites have the same characteristics as SNOTEL—they sit near basin divides, at high elevation, and away from the tree canopy—and the SWE and snow depth measurements at snow courses are made at six locations in a 50-foot transect. They have one major drawback, however: they are periodic, made only when someone visits the site, so weeks can pass without insight into the snowpack conditions. In that time, intense storms can dump copious snow or rain, or a warm spell can cause rapid melting that elevates flood risk.

New Mexico has 23 SNOTEL and 39 snow courses (Figure 2). Arizona has 21 and 23 respectively, including the newest station, which was installed in October in the Four Corners region of Arizona. SNOTEL stations have made data collection easier and more rapid, but snow courses remain vital.

"We still want to have manual measurements to help ground-truth the SNOTEL data," De Simone said. "When we install a new station we often locate them near a snow course. If the measurements are similar over a five-year period, the snow course site isn't necessary."

Automated SNOTEL stations are high tech compared to the old fashion stations.

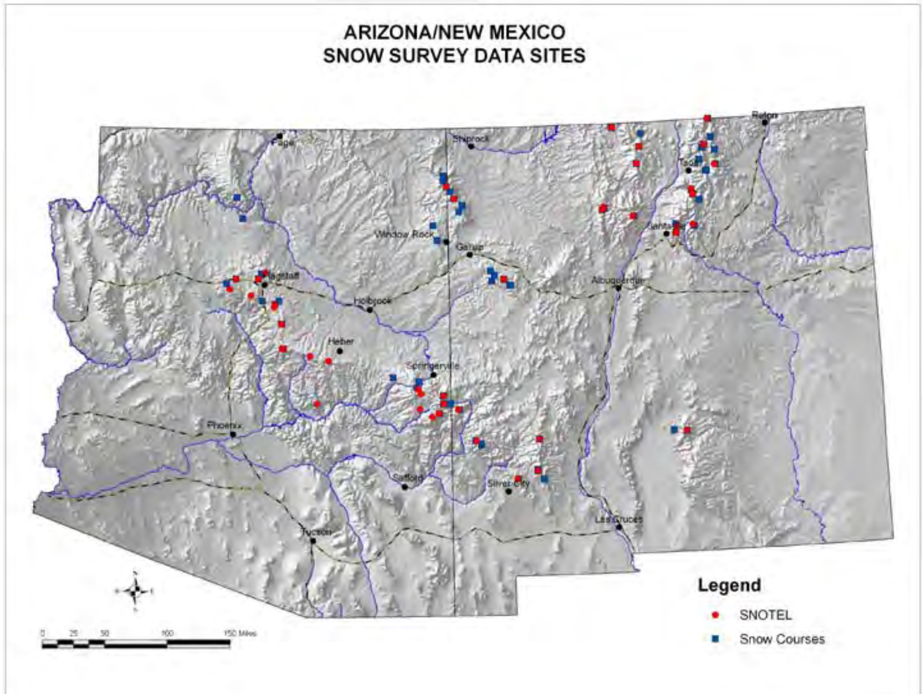


Figure 2. There are 21 SNOTEL stations and 23 snow courses in Arizona, while New Mexico tallies 23 and 39, respectively. Map courtesy of Dino De Simon, NRCS.

The basic SNOTEL station provides snowpack, water content, snow depth, precipitation, and air temperature data. The more sophisticated SNOTEL stations also are equipped to measure soil moisture and temperature at various depths.

The data generated by SNOTEL and snow course measurements are used by researchers, state climatologists, and fire and forest managers. The greatest value of the information, however, is found in the streamflow forecasts that are built on the snow measurements. These forecasts are used by irrigation districts and for reservoir operation, domestic water use, power generation, and flood control.

Streamflow forecasting

Most of the usable water in the western states originates as mountain snowfall. This snowfall accumulates during winter and spring, several months before the snow melts and appears as streamflow. Because the runoff from snow is delayed, estimates of snowmelt runoff can be made in advance.

In Arizona, forecasts from spring streamflow are made every two weeks between January 1 and April 1. Forecasts are issued once a month and continue through May 1 for New Mexico and through June 1 for the Upper Colorado River Basin states, where snow tends to linger on the landscape.

The NRCS bases its streamflow forecasts on a statistical model that uses historical relationships between SWE at a given date, total precipitation since the water year began on October 1, and the spring streamflow. A linear relationship between these three variables allows estimates of spring runoff to be computed as long as the SWE and total accumulated precipitation is measured.

The model works well in snow-dominated systems like the Upper Colorado River Basin, said Angus Goodbody, forecast hydrologist for the NRCS. But forecasting for Arizona and southern portions of New Mexico is challenging because a

continued on page 4

Monitoring snowpack and forecasting streamflows in the Southwest, continued

single large precipitation event can swamp the winter totals, and temperatures at higher elevations often can be above the freezing point, melting snow before spring arrives.

"We deal with the trickiness in Arizona by forecasting streamflows every two weeks, which allows us to see big storms approaching," said Goodbody.

But, he said, the statistical model prevents early winter forecasts from projecting high spring streamflows generated by extremely wet winters, like this year. Even though forecasters knew El Niño increased the likelihood of big storms, the streamflow forecasts were low in the beginning of the winter, said Goodbody.

Forecasts of spring runoff at the beginning of the winter, for example, can give a broad brush new of what to expect, Goodbody said. Most of the error in long-lead forecasts comes from one unknown variable—future weather—and forecasters will never be able to hone in on a specific streamflow forecast number until weather forecasting improves, he continued.

Forecasts become more accurate as the winter unfolds and more of the total precipitation has fallen. In snow-dominated basins like those in the upper Colorado River, measurements of SWE and total precipitation since October 1 made on April 1 can explain 80–90 percent of the expected streamflow in June. The other 10–20 percent comes from the whims of the weather.

The NRCS is not the only organization in the business of streamflow forecasting. The National Weather Service has 13 River Forecast Centers (RFC) in the U.S. that also issue forecasts. For the Colorado River basin, the RFC uses a similar statistical approach as the NRCS but also incorporates a hydrologic model. These two groups generate independent forecasts, discuss each together, and then issue one official forecast after reconciling the differences, if any.

Is the drought over?

For the 2009–10 winter, all of the major river basins monitored by SNOTEL stations in Arizona had more than twice the average snowfall as of March 15. It's a similar story in central and southern New Mexico; stations in the Mimbres watershed, which drains the southwestern corner of the state, posted more than three times the average snowfall.

After one of the driest monsoon seasons on record, the constant stream of winter storms improved or expunged short-term drought conditions in the region, leaving some to wonder if the drought is over.

"It's hard to argue that short-term drought is not over in many parts of the Southwest," said Mike Crimmins, a climate science extension specialist for the University of Arizona and affiliate of the Climate Assessment for the Southwest (CLIMAS).

Rain and snow since about December 1 will help moisten the deep soils, which will dampen fire risk in the spring. Rivers will swell in the spring, and extra water will flush through the system in some basins with reservoirs near full capacity. This will likely inject more water into aquifers, although how much is anyone's guess. Trees and winter vegetation also will flourish.

There are caveats, however. The winter storms bypassed the Upper Colorado River Basin; as a result, forecasts suggest that spring streamflow into Lake Powell will be around 67 percent of average.

In addition, it is difficult to assess the effects of one season's drought on the following season. The dry monsoon season, for example, likely caused grasses to release fewer seeds. There is a chance that even with an average monsoon season in 2010, pastures will be less robust because fewer seeds germinated. Another nuance is that the ecosystem of the Southwest is primed for seasonal rain. If it comes, all is green. If it doesn't, drought recurs.

"Drought comes and goes rapidly," Crimmins said. By the time summer rolls around, most of the wet winter will be a distant memory.

Temperature (through 3/17/10)

Source: High Plains Regional Climate Center

Temperatures since the water year began on October 1 show the distinct elevation patterns of Arizona and New Mexico, with the lower deserts averaging between 50 and 65 degrees Fahrenheit in Arizona and 45 and 50 degrees F in southern New Mexico (Figure 1a). Temperatures in the Colorado Plateau and northern New Mexico ranged from 35 to 45 degrees F. Average temperatures in the higher elevations of both states were between 30 and 35 degrees F. As a result of a relatively strong El Niño circulation, which has brought frequent storms to the Southwest, these temperatures generally have been 1–3 degrees F below average in northern Arizona, and 1–5 degrees colder than average in New Mexico (Figure 1b). Only the central Arizona desert, southeastern Arizona, and southwestern New Mexico have seen temperatures between 0 and 2 degrees F warmer than average. For south-central New Mexico, the warm conditions are related to drier-than-average conditions. Eastern New Mexico has been particularly cool, with temperatures ranging from 2 to 4 degrees F below average.

The past 30 days have been very cold with temperatures ranging from 0 to 6 degrees F below average in Arizona and most of New Mexico (Figures 1c–d). The Sangre de Cristo Mountains of northern New Mexico have been 4–8 degrees colder than average for this time of year. Although the storm systems in January and early February were generally much warmer than average, the series of storms in the past month has been much colder than average.

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 '09–'10 (through March 17) average temperature.

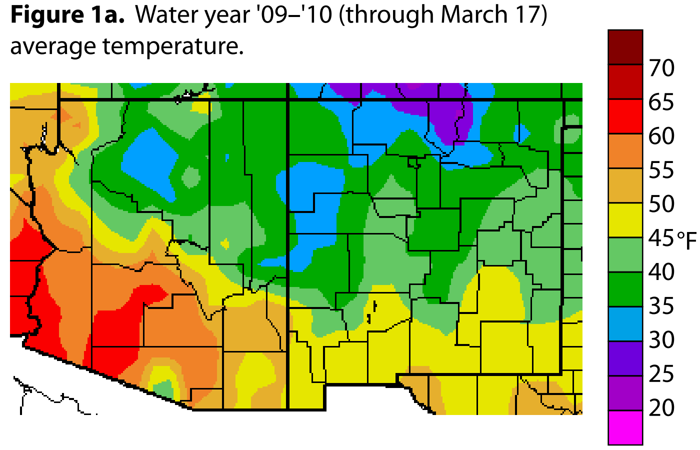


Figure 1b. Water year '09–'10 (through March 17) departure from average temperature.

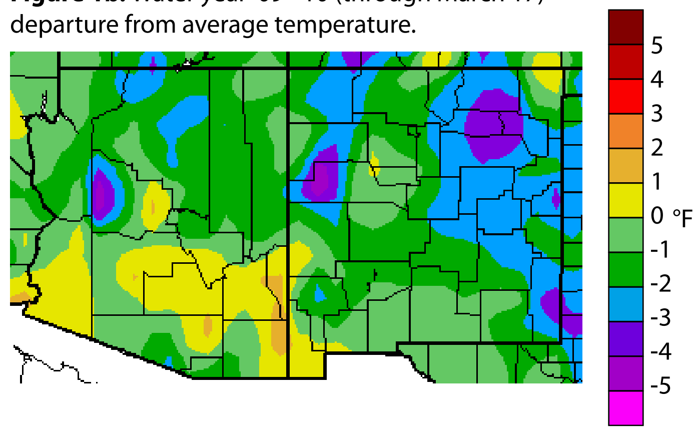


Figure 1c. Previous 30 days (February 16–March 17) departure from average temperature (interpolated).

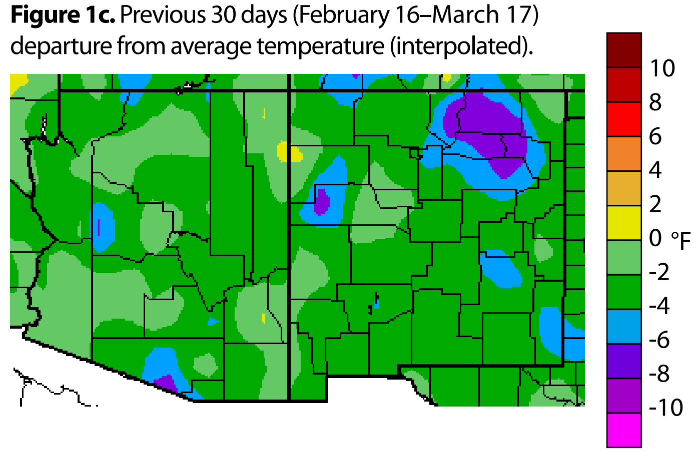
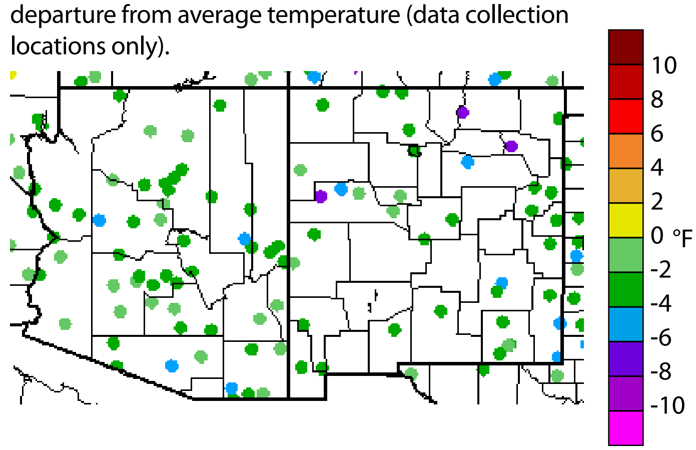


Figure 1d. Previous 30 days (February 16–March 17) departure from average temperature (data collection locations only).



Precipitation (through 3/17/10)

Source: High Plains Regional Climate Center

The El Niño circulation pattern has continued to bring wet winter storms to the southwestern states, although western Arizona and eastern New Mexico have received the bulk of the precipitation (Figures 2a–b). Central Arizona has received 100–130 percent of average precipitation while western Arizona and eastern New Mexico have received 150–300 percent. Eastern Arizona and west-central and central New Mexico are still dry for the water year, with 25 to 90 percent of average precipitation.

During the past 30 days, east-central and southeastern New Mexico have been particularly dry, receiving 2–75 percent of average precipitation (Figures 2c–d). North-central Arizona, across the Colorado Plateau, also has been dry, with 50–100 percent of average. Eastern New Mexico, northwestern Arizona, and south-central Arizona have been extremely wet, receiving 150–400 percent of average precipitation, most of it falling as snow.

Figure 2a. Water year '09–'10 (through March 17) percent of average precipitation (interpolated).

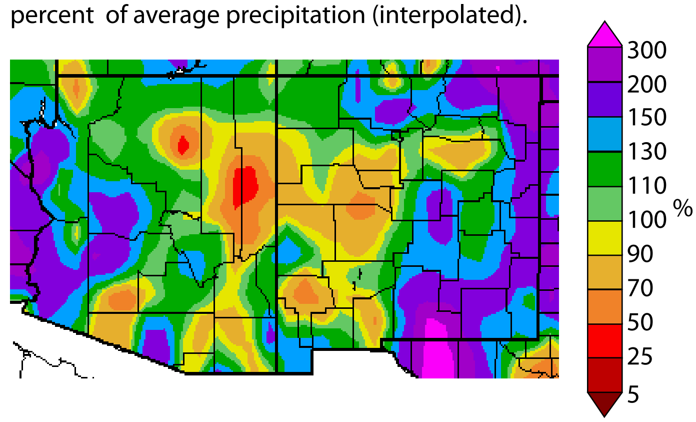


Figure 2b. Water year '09–'10 (through March 17) percent of average precipitation (data collection locations only).

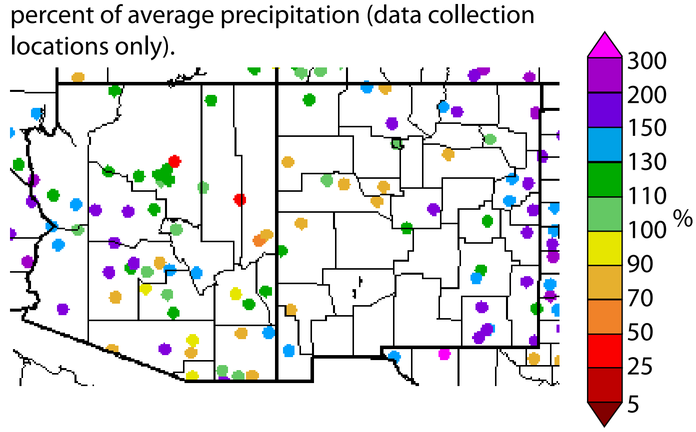


Figure 2c. Previous 30 days (February 16–March 17) percent of average precipitation (interpolated).

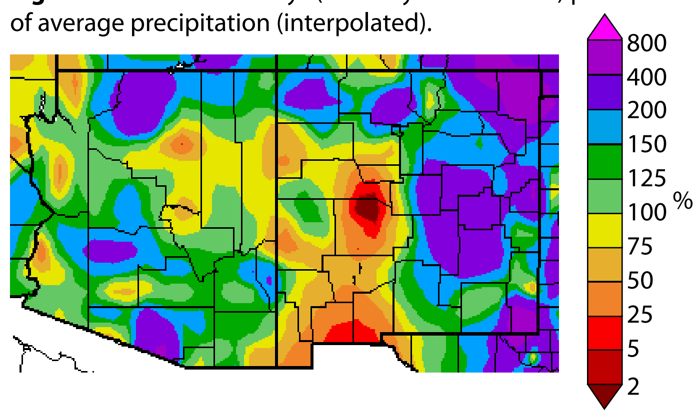
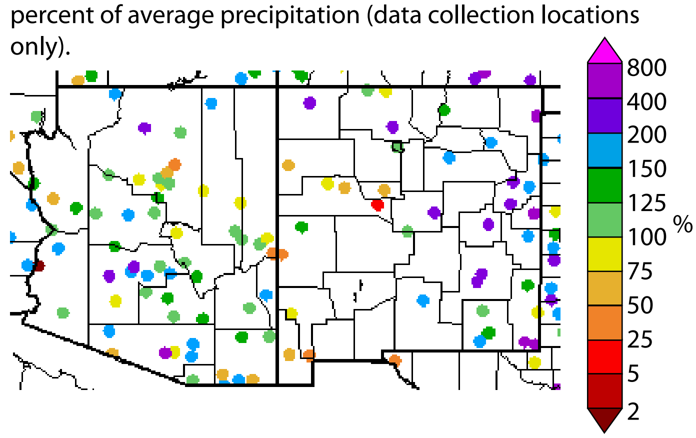


Figure 2d. Previous 30 days (February 16–March 17) percent of average precipitation (data collection locations only).



Notes:

The water year begins on October 1 and ends on September 30 of the following year. As of October 1, 2009, we are in the 2010 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

U.S. Drought Monitor

(data through 3/16/10)

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

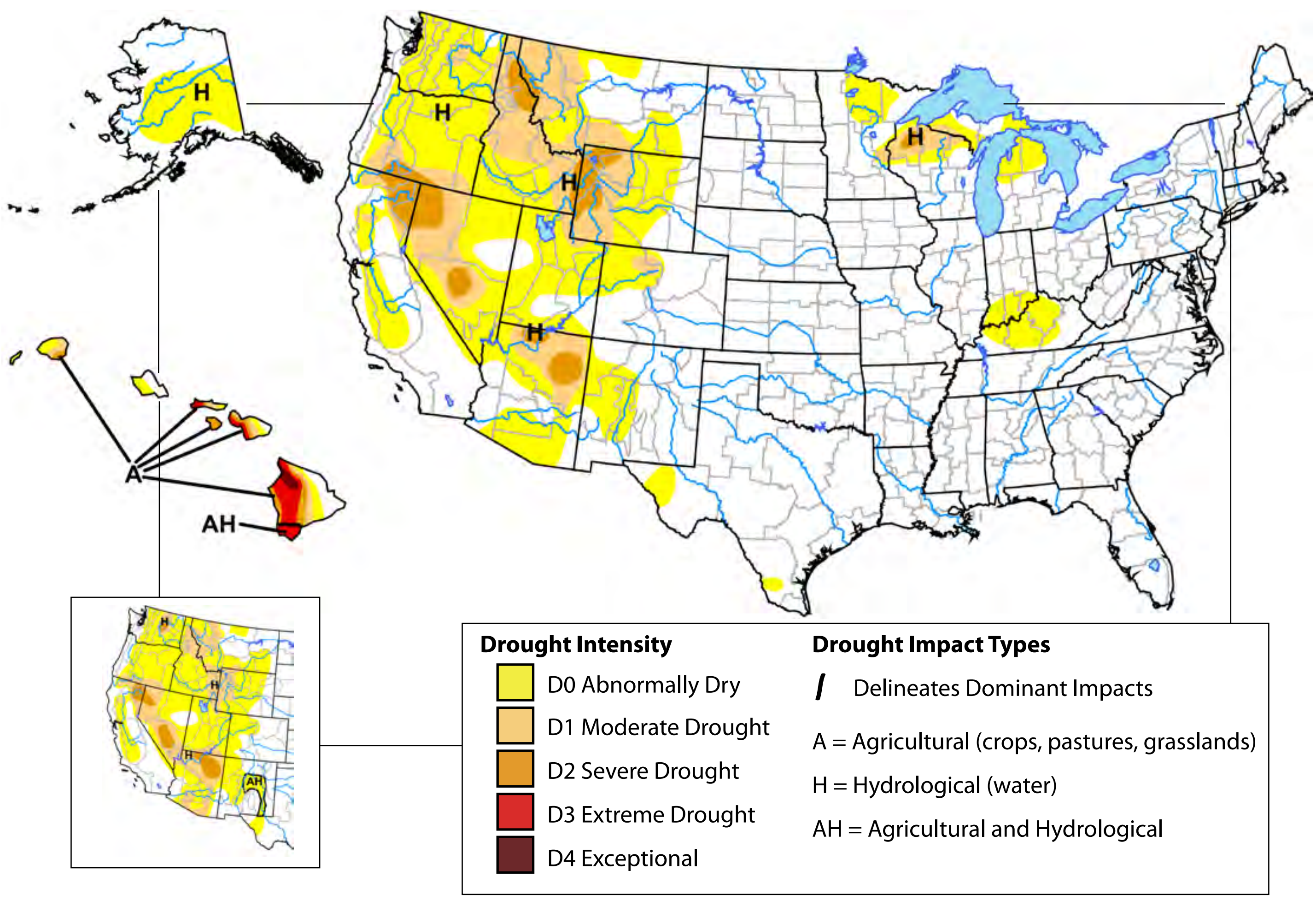
Wet conditions in the Southwest and dry weather in the Pacific Northwest and northern Rockies continued this month, further effecting the pattern of drought across the western U.S. (Figure 3). Overall, the geographic area impacted by drought fell slightly—from 66 percent to 62 percent of the western U.S. between mid-February and mid-March—but the area of severe drought increased from 3.5 percent to 5.6 percent. The main areas of expansion were in the northern Rockies, where several new areas of severe drought emerged in northern Idaho and western Wyoming. This area has seen one of its driest winters on record. Spokane, Wash., observed its least snowy winter on record, and the last time Missoula, Mont., saw so little snow was in 1947(*USA Today*, March 11). Irrigation water shortages this spring are a concern across the region.

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 several agencies; the author of this monitor is Matthew Rosencrans, NOAA/NWS/NCEP/CPC.

Figure 3. Drought Monitor data through March 16 (full size), and February 16 (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

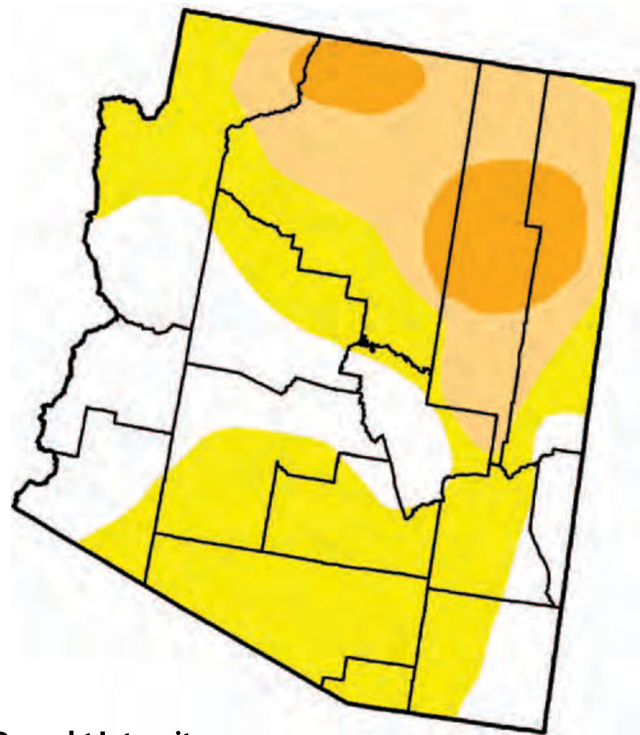
Arizona Drought Status

(data through 3/16/10)

Source: U.S. Drought Monitor

The wet weather continued across Arizona this past month, bringing additional relief to short-term drought conditions across the state. The March 16 update of the National Drought Monitor depicted normal to abnormally dry conditions across the southern half of the state, with some moderate and severe drought conditions continuing in the northern regions (Figure 4a). Moderate drought conditions improved last month, covering about 28 percent of the state compared with 50 percent (Figure 4b). The pattern of improvement was consistent with precipitation patterns. Much of the southern half of the state observed above-average precipitation, with some areas reporting 150 to 400 percent of average rainfall totals for the past 30 days. Fewer drought impacts were reported to Arizona DroughtWatch this past month, further indication that drought conditions are improving across the state (http://azdroughtwatch.org). The reports submitted continue to reference impacts that emerged during the unusually dry 2009 monsoon season. Ranchers in Greenlee County, for example, indicated that water levels in stock ponds and tanks are still unusually low, and an expert naturalist in Pima County observed that some invasive grasses are doing quite well in areas left bare from the dry summer and fall conditions.

Figure 4a. Arizona drought map based on data through March 16.



Drought Intensity

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional

Figure 4b. Percent of Arizona designated with drought conditions based on data through March 16.

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	28.5	71.5	27.6	9.0	0.0	0.0
Last Week (03/09/2010 map)	23.7	76.3	30.3	9.2	0.0	0.0
3 Months Ago (12/22/2009 map)	0.0	100.0	97.2	71.2	5.1	0.0
Start of Calendar Year (01/05/2010 map)	0.0	100.0	97.2	71.1	5.1	0.0
Start of Water Year (10/06/2009 map)	1.4	98.6	80.3	10.7	0.0	0.0
One Year Ago (03/17/2009 map)	61.1	38.9	1.6	0.0	0.0	0.0

Notes:

The Arizona 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 several agencies.

On the Web:

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

For monthly short-term and quarterly long-term Arizona drought status maps, visit:
http://www.azwater.gov/AzDWR/StatewidePlanning/Drought/DroughtStatus.htm

New Mexico Drought Status

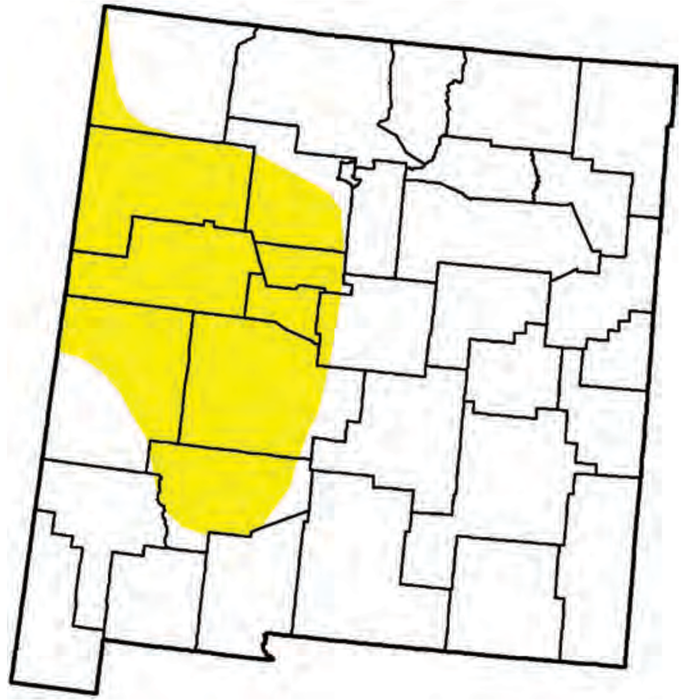
(data through 3/16/10)

Source: New Mexico State Drought Monitoring Committee , U.S. Drought Monitor

New Mexico drought conditions are less severe in magnitude and intensity than they are in Arizona. Only about 24 percent of the state is classified with abnormally dry conditions, and no areas have conditions worse than that (Figure 5a). During the past month, abnormally dry conditions that stretched from the northwest to southeast corners of the state retreated to a small area in west-central New Mexico, according to the March 16 update of the National Drought Monitor. Wet weather during the past several months has helped bring a drought-free classification to more than 76 percent of New Mexico, an increase of about 20 percent since the start of the calendar year (Figure 5b). Much of the state has observed average to above-average precipitation over the past 30 days, with some areas receiving 150–400 percent of average during this period.

In an effort to improve water management in the face of drought and growing water demands, New Mexico's Governor Bill Richardson is pushing for a plan that would give special protection to many of the state's waterways (businessweek.com, March 18). The initiative would declare hundreds of miles of rivers and thousands of acres of wetlands in New Mexico as Outstanding National Resource Waters under the Clean Water Act. Ranchers and farmers are concerned this sweeping measure will limit their access to many streams in rural parts of the state, where these water sources are critical for livestock and agricultural production.

Figure 5a. New Mexico drought map based on data through March 16.



Drought Intensity

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional

Figure 5b. Percent of New Mexico designated with drought conditions based on data through March 16.

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	76.3	23.7	0.0	0.0	0.0	0.0
Last Week (03/09/2010 map)	76.3	23.7	0.0	0.0	0.0	0.0
3 Months Ago (12/22/2009 map)	56.9	43.1	10.1	2.3	0.0	0.0
Start of Calendar Year (01/05/2010 map)	56.9	43.1	10.1	2.3	0.0	0.0
Start of Water Year (10/06/2009 map)	72.2	27.8	3.4	0.0	0.0	0.0
One Year Ago (03/17/2009 map)	44.5	55.6	16.5	0.0	0.0	0.0

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 several agencies.

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

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

Arizona Reservoir Levels

(through 2/28/10)

Source: NRCS, National Water and Climate Center

Water storage in Lake Powell declined by 215,000 acre-feet in February, putting the reservoir at 57 percent of capacity (Figure 6). Lake Mead, on the other hand, gained 287,000 acre-feet. Combined storage in these large Colorado River reservoirs is approximately 51 percent of capacity. Storage in reservoirs within Arizona's borders increased in February, including the Salt and Verde river basin systems, which have storage levels far above average—the Salt River system is nearly at 100 percent capacity.

Releases from the Salt and Verde river basin systems are being sent to Painted Rock Reservoir on the Gila River (*Arizona Republic*, March 17). Water impounded by this dam, which is used for flood control, will be released to the lower Gila River and should reach the Colorado River in the next few weeks, contributing to the United States' Colorado River deliveries to Mexico. Also, due to substantial winter precipitation, farmers have used 575,000 acre-feet less than anticipated, allowing for the increases in Lake Mead during the last two months.

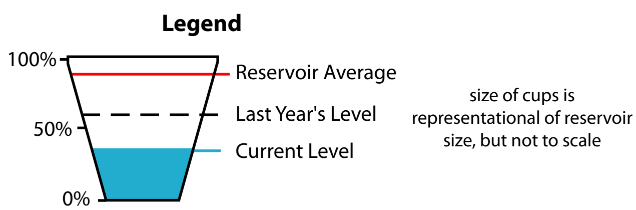
Notes:

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.

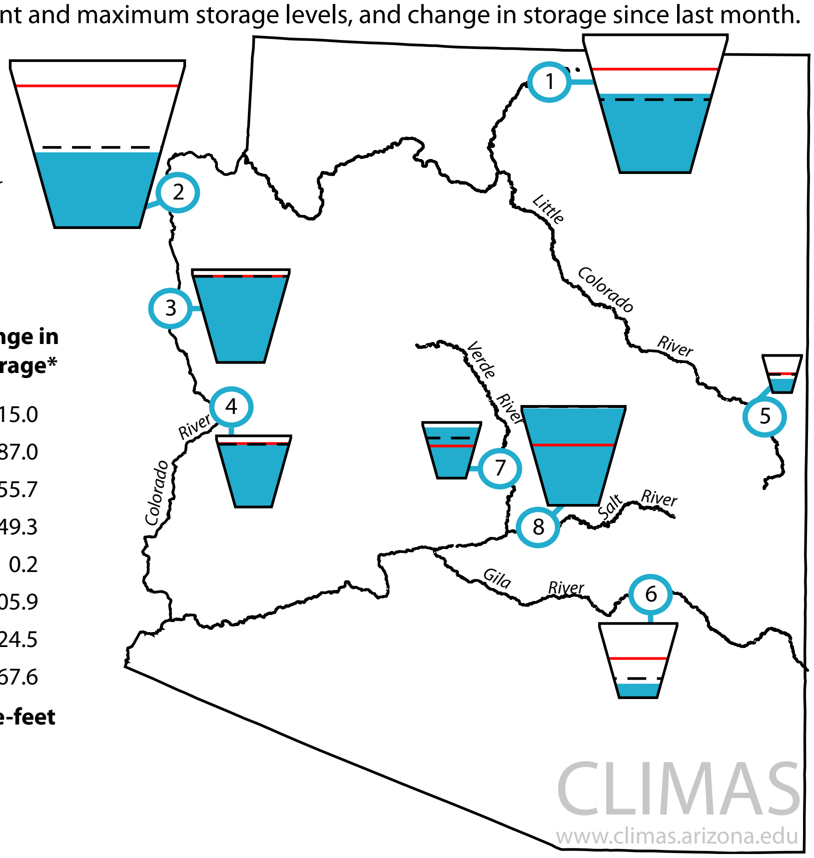
These data are based on reservoir reports updated monthly by the National Water and Climate Center of the U.S. Department of Agriculture's Natural Resource Conservation Service (NRCS). For additional information, contact Dino DeSimone, Dino.DeSimone@az.usda.gov.

Figure 6. Arizona reservoir levels for February 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	57%	13788.0	24,322.0	-215.0
2. Lake Mead	45%	11780.0	26,159.0	287.0
3. Lake Mohave	93%	1679.9	1,810.0	-55.7
4. Lake Havasu	89%	548.0	619.0	-49.3
5. Lyman Reservoir	37%	11.2	30.0	0.2
6. San Carlos	19%	169.4	875.0	105.9
7. Verde River System	91%	261.4	287.4	24.5
8. Salt River System	98%	1993.1	2,025.8	67.6

*** 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 2/28/10)

Source: NRCS, National Water and Climate Center

The total reservoir storage in New Mexico increased by about 40,200 acre-feet in February (Figure 7). Caballo and Sumner reservoirs gained substantial increases in storage, tallying increases of about 30,000 and 10,000 acre-feet, respectively. The largest storage decreases were in Navajo Reservoir, which stands at near-average storage.

In water-related news, Governor Bill Richardson signed New Mexico House Bill 15, which changes the Eastern New Mexico Rural Water Authority into a utility authority (cnjonline.com, March 6). The measure clears the way for implementation of the Ute Water Project, a $432 million pipeline that pumps water from the Ute Reservoir in Quay County to the authority's member entities, including Clovis, N.Mex. Water project costs will be distributed to the federal government (75 percent), state (15 percent), and local entities (10 percent).

Notes:

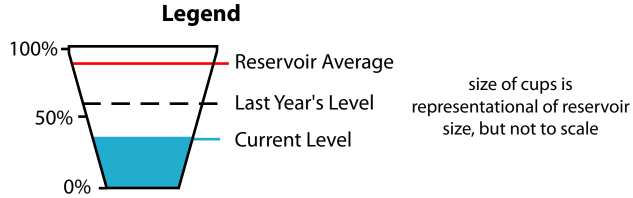
The map gives a representation of current storage levels for reservoirs in New Mexico. Reservoir locations are numbered within the blue circles on the map, corresponding to the reservoirs listed in the table. The cup next to each reservoir shows the current storage level (blue fill) as a percent of total 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 Wayne Sleep, wayne.sleep@nm.usda.gov.

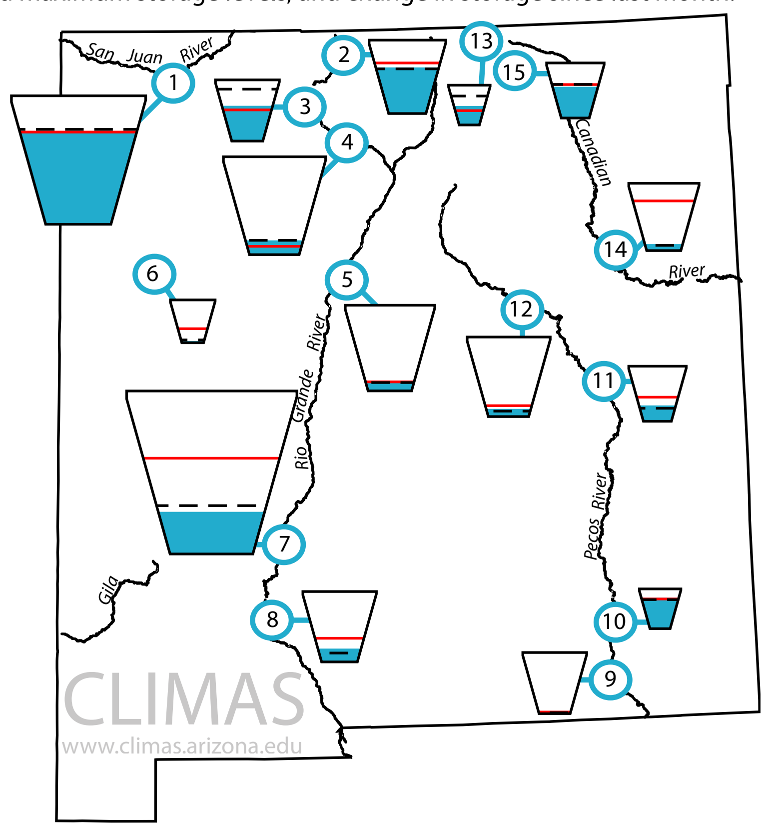
Figure 7. New Mexico reservoir levels for February as a percent of capacity. The map depicts the average level and last year's storage for each reservoir. The table also lists current and maximum storage levels, and change in storage since last month.

Legend



Reservoir Name	Capacity Level	Current Storage*	Max Storage*	Change in Storage*
1. Navajo	72%	1,214.3	1,696.0	-11.7
2. Heron	63%	251.5	400.0	0.4
3. El Vado	58%	111.0	190.3	-0.5
4. Abiquiu	15%	182.3	1,192.8	-1.0
5. Cochiti	11%	53.1	491.0	0.1
6. Bluewater	4%	1.7	38.5	0.1
7. Elephant Butte	26%	567.1	2,195.0	5.6
8. Caballo	19%	61.8	332.0	30.2
9. Brantley	2%	22.2	1,008.2	3.2
10. Lake Avalon	78%	3.1	4.0	0.4
11. Sumner	29%	30.0	102.0	10.1
12. Santa Rosa	10%	44.9	438.3	0.7
13. Costilla	48%	7.6	16.0	0.4
14. Conchas	10%	25.5	254.2	1.5
15. Eagle Nest	57%	44.9	79.0	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

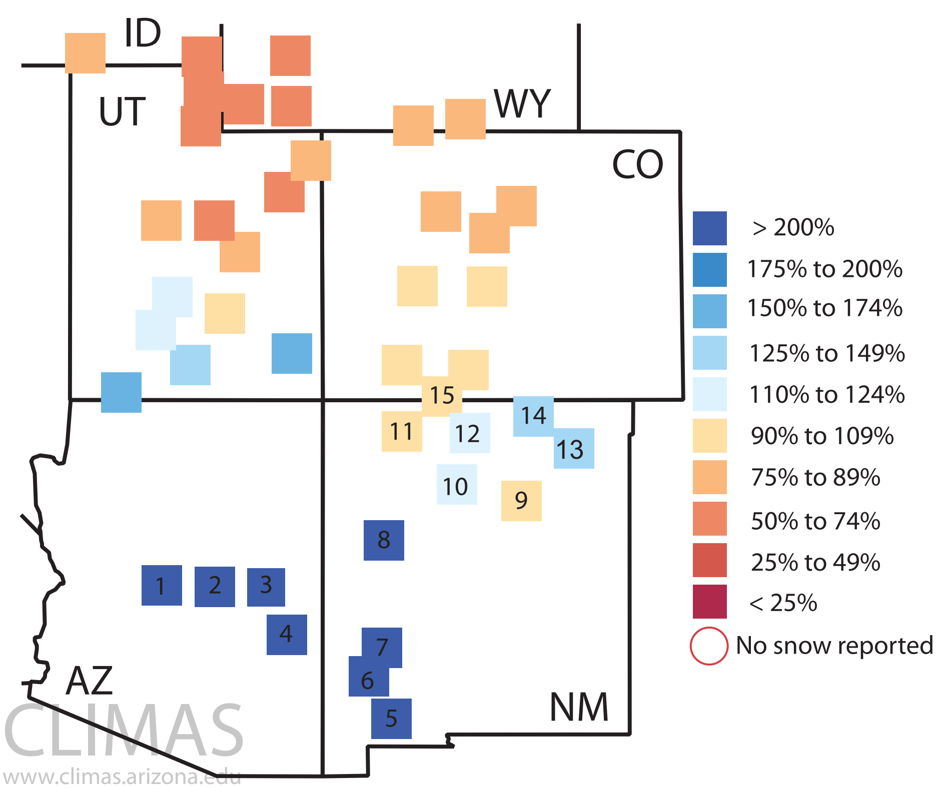
Southwest Snowpack

(updated 3/18/10)

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

Snowpack levels remain above average in all river basins across Arizona and New Mexico except the Animas Basin in New Mexico (Figure 8). The snow water equivalent (SWE) in the snowpack in Arizona ranged from 214 percent of average in the Salt River Basin to 324 percent of average in the Verde River Basin as of March 18, according to the Natural Resources Conservation Service's snow telemetry (SNOTEL) monitoring stations (see also the feature article on SNOTEL, page 3). New Mexico basins had a broader range of SWE, from 97 percent of average in the Animas River Basin to 340 percent in the Mimbres River Basin. Snowpack for the San Francisco River Basin was 209 percent of average and was reported on March 23. The hefty snowpack bodes well for streamflows, and forecasts suggest the likelihood that most rivers will experience above-average spring streamflows (see page 17). Snow conditions, however, are not all rosy. The Upper Colorado River Basin, which supplies most of the water in the Colorado River, has experienced average to below-average snowpacks. SNOTEL sites in the Gunnison and Upper Colorado river watersheds, for example, reported SWE conditions of 79 and 96 percent of average, respectively.

Figure 8. Average snow water equivalent (SWE) in percent of average for available monitoring sites as of March 18.



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

The accumulation of snow in the higher elevations of Arizona and New Mexico has been influenced by El Niño, which has helped steer many storms into the Southwest this winter. Because El Niño conditions are forecasted to persist into April, snowpacks may continue to build or be sustained for another month or so.

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. SWE 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 SWE than light, powdery snow.

This figure shows the SWE 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. CLIMAS generates this figure using daily SWE measurements made by the Natural Resources Conservation Service.

On the Web:

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

For NRCS source data, visit:
http://www.wcc.nrcs.usda.gov/snow/

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

Temperature Outlook

(April–September 2010)

Source: NOAA-Climate Prediction Center (CPC)

The NOAA–Climate Prediction Center (NOAA–CPC) long-lead temperature outlooks show elevated chances for temperatures during April–June in all of Arizona and western New Mexico to be similar to the warmest 10 years in the 1971–2000 climatological record (Figure 9a). Chances increase for warmer temperatures for the two-, three-, and four-month lead times (Figures 9b–d). There is more than a 50 percent chance that temperatures during the May–July and July–September periods will be similar to the warmest 10 years of the 1971–2000 record in most of Arizona and western regions of New Mexico (Figures 9b and d). The outlook for elevated changes of warmer temperatures into the summer in large part reflects the recent warming trends during the hot foresummer and summer in 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 no forecast skill has been demonstrated or there is no clear climate signal; 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 April–June 2010.

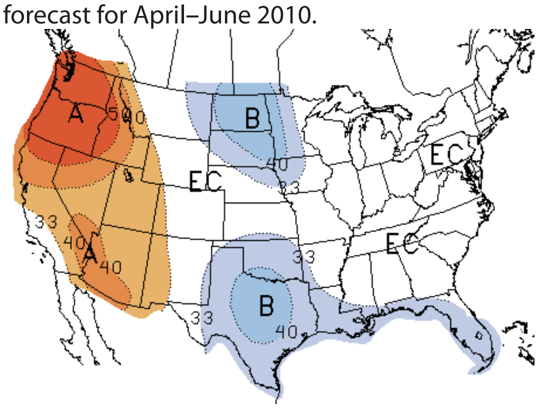
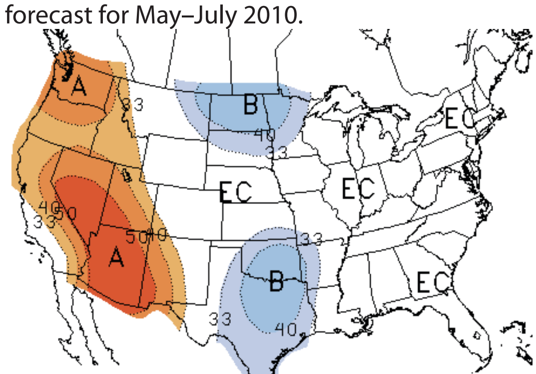


Figure 9b. Long-lead national temperature forecast for May–July 2010.



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 June–August 2010.

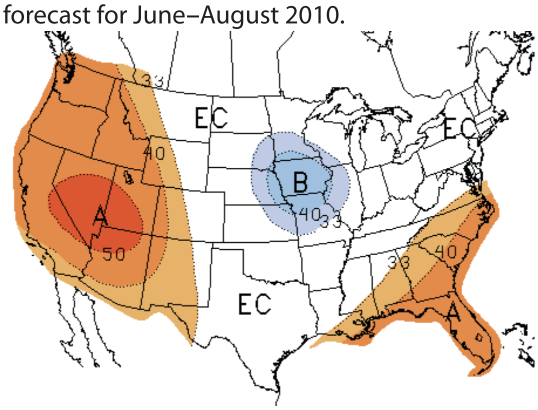
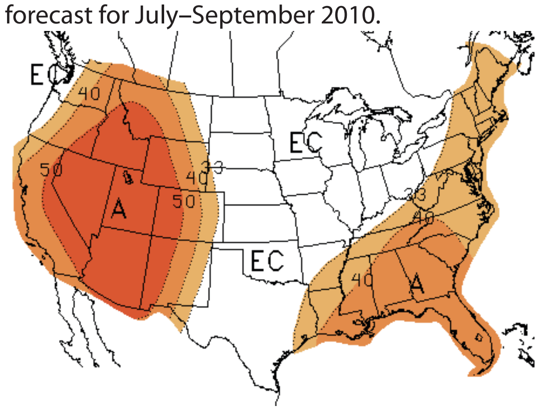


Figure 9d. Long-lead national temperature forecast for July–September 2010.



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.php
(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

(April–September 2010)

Source: NOAA-Climate Prediction Center (CPC)

The NOAA–Climate Prediction Center (NOAA–CPC) long-lead precipitation outlooks for the April–June period indicate slightly elevated chances that precipitation in northern Arizona and New Mexico will be similar to the wettest 10 years in the 1971–2000 climatological record (Figure 10a). April–June is the driest three-month period in Arizona; precipitation averaged only 1.27 inches during 1971–2000. Average precipitation for April–June in New Mexico between 1971–2000 was 2.97 inches. NOAA–CPC forecasting models do not show skill in predicting conditions for late spring into summer, and the forecasts therefore show equal chances of above-, below-, and near-average precipitation throughout much of the Southwest (Figures 10b–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 no forecast skill has been demonstrated or there is no clear climate signal; 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 April–June 2010.

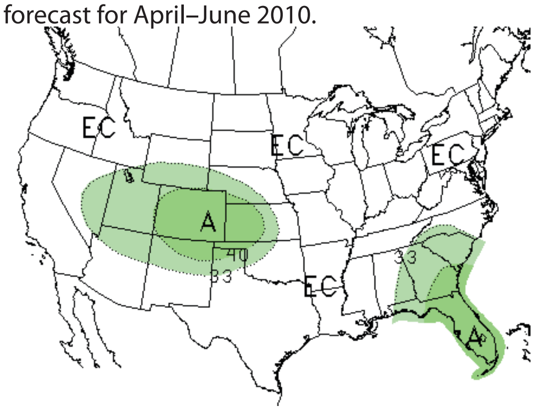
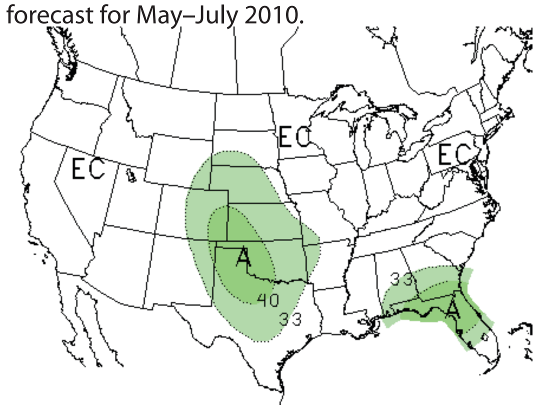


Figure 10b. Long-lead national precipitation forecast for May–July 2010.



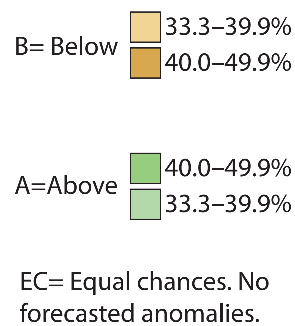


Figure 10c. Long-lead national precipitation forecast for June–August 2010.

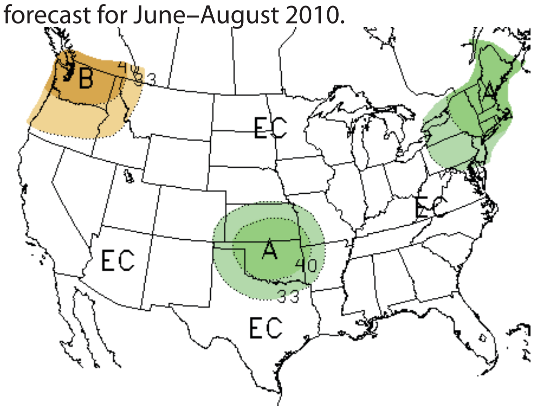
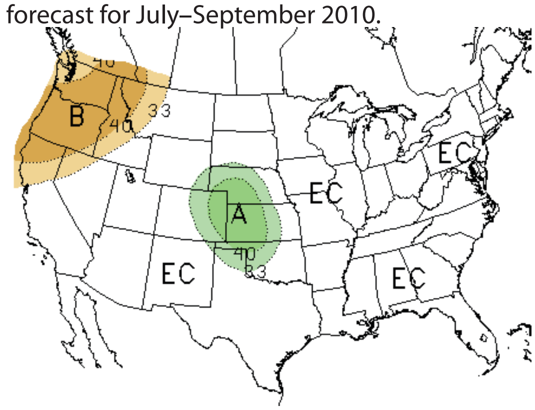


Figure 10d. Long-lead national precipitation forecast for July–September 2010.



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.php
(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 June)

Source: NOAA-Climate Prediction Center (CPC)

This summary is excerpted and edited from the March 18 Seasonal Drought Outlook technical discussion produced by NOAA–CPC and written by forecasters D. Miskus and B. Pugh.

Currently, about 72 percent of Arizona and 24 percent of New Mexico are classified by the U.S. Drought Monitor as having abnormally dry conditions or worse (see pages 9 and 10). The Seasonal Drought Forecast that covers March 18 through June calls for improvements in drought conditions in northern parts of Arizona, particularly on the Navajo Nation (Figure 11).

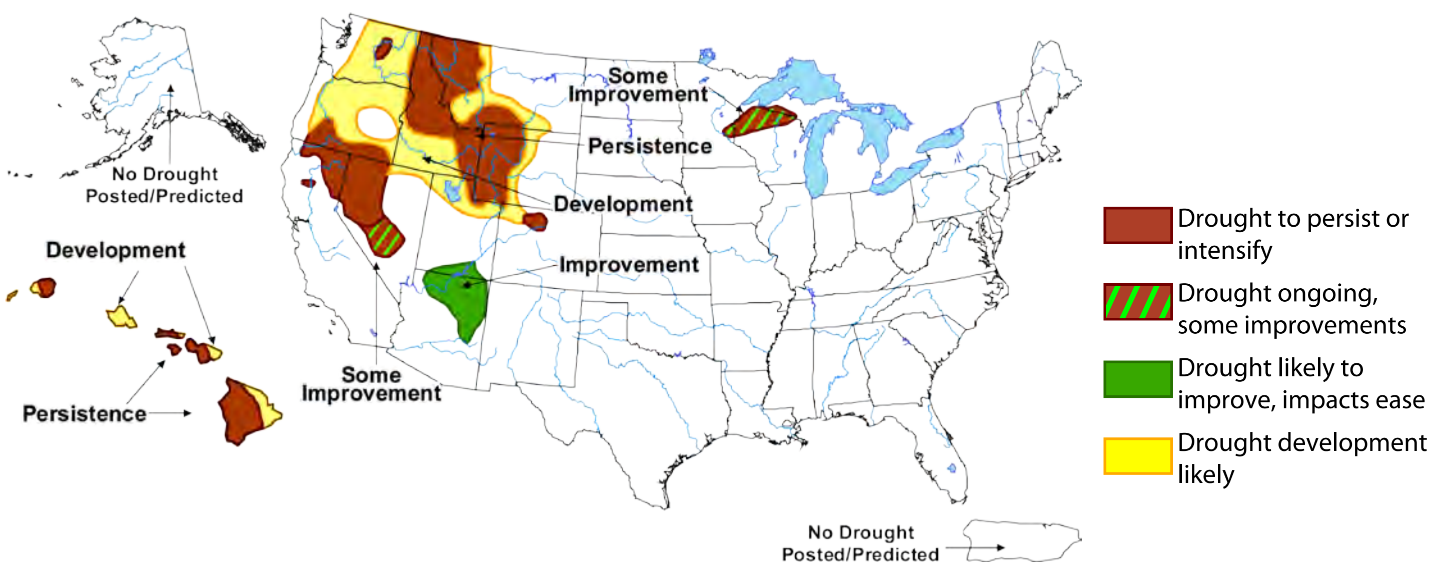
In the Southwest, a wet pattern has generally prevailed during the past three weeks and most of the winter. This has led to additional reductions of drought and abnormal dryness in parts of Arizona and southern Nevada in the latest U.S. Drought Monitor, as precipitation and stream flows are generally at or above average. Exceptions to this, however, include far northeastern California and adjoining northwestern Nevada, where little relief has occurred. The seasonal precipitation outlook by the NOAA Climate Prediction Center (NOAA–CPC) calls for elevated chances for above-average precipitation for the April–June period. This outlook, combined with near-record snow water equivalent (SWE) on March 17 and water year precipitation totals across much of Arizona and southern Utah, points to continued improvement in these two regions (see page 13).

Elsewhere in the Southwest, drought likely will develop in northern Utah, northwestern Colorado, and southwestern Wyoming. This forecast is based principally on the low total precipitation since the water year began on October 1 (61–87 percent of average) and the snow water content (52–85 percent of average) as of March 17. Above-average temperatures in both the one- and three-month NOAA–CPC outlooks also favor drought development because warmer conditions will melt snowpack sooner, causing the landscape to dry more quickly. The confidence in the forecasts for California, Nevada, and the Four Corners region is moderate.

Notes:

The delineated areas in the Seasonal Drought Outlook are defined subjectively and are based on expert assessment of numerous indicators, including the official precipitation outlooks, various medium- and short-range forecasts , models such as the 6-10 day and 8-14 day forecasts, soil moisture tools, and climatology.

Figure 11. Seasonal drought outlook through June (released March 18).



On the Web:

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

For medium- and short-range forecasts, visit:
http://www.cpc.ncep.noaa.gov/products/forecasts/

For soil moisture tools, visit:
http://www.cpc.ncep.noaa.gov/soilmst/forecasts.shtml

Streamflow Forecast

(for spring and summer)

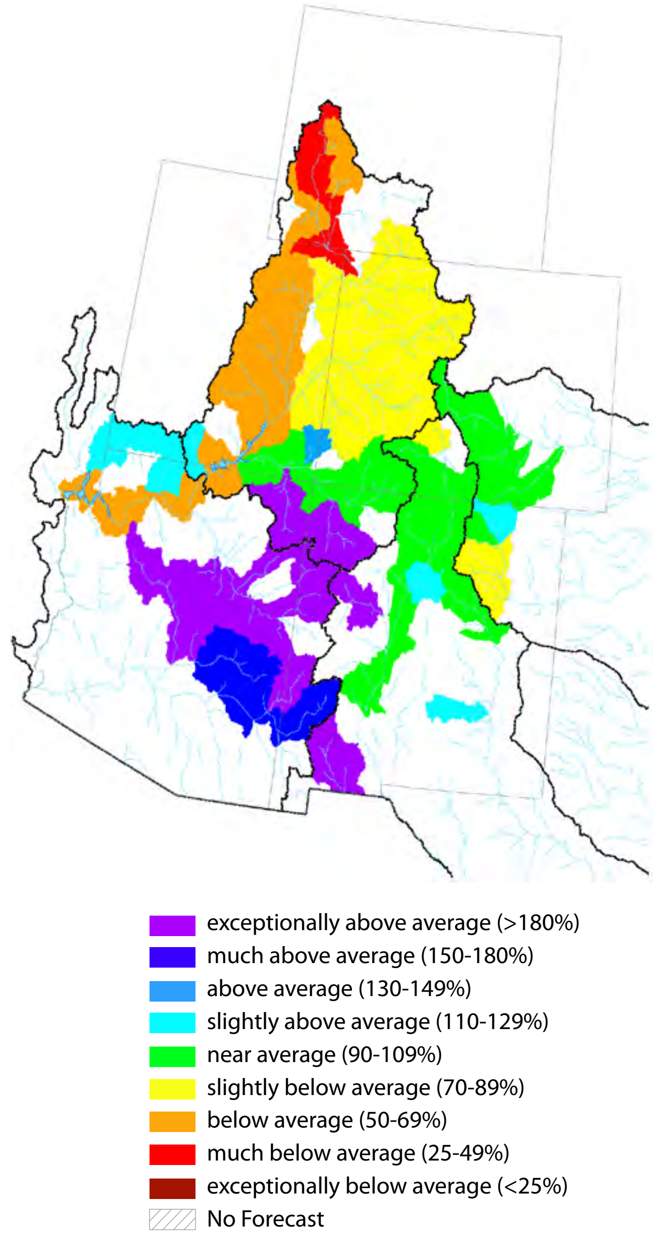
Source: National Water and Climate Center

The spring–summer streamflow forecast issued on March 1 for the Southwest shows that most forecasted watersheds in Arizona and western New Mexico have at least a 50 percent chance of experiencing above-average flows (Figure 12). The forecast for the Upper Colorado River Basin, however, calls for less-than-average streamflow. These forecasts reflect the high snow water equivalent (SWE) in the snowpacks of Arizona and New Mexico and the low SWE in Colorado, Utah, and Wyoming. In some basins in Arizona, SWE is close to record levels for this time of year.

Streamflow forecasts in Arizona are issued every two weeks. As of March 15, the Salt, Verde, Little Colorado, and Gila River basins had a 50 percent change of generating 189, 260, 293, and 229 percent of the 1971–2000 average. Inflow into Lake Powell, however, had a 50-50 chance of delivering less than 67 percent of average water to the reservoir. This corresponds to about 5.3 million acre-feet, approximately 2.6 million acre-feet less than the 1971–2000 average.

Streamflow forecasts for New Mexico are issued on the first day of each a month. River basins in the south and west of the state generally are expected to generate above-average flows, while basins in the north and eastern part of the state will experience near- or below-average flows. The March 1 forecast states that the Canadian, Pecos, and Rio Grande river basins have a 50 percent chance of generating 79, 106, and 100 percent of average streamflow, respectively. The Mimbres and Upper Gila, on the other hand, will likely produce 464 and 191 percent of average, respectively.

Figure 12. Spring and summer streamflow forecast as of March 1 (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 March and April, and for New Mexico between March 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/wsf/westwide.html

El Niño Status and Forecast

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

An El Niño Advisory issued by the NOAA Climate Prediction Center (NOAA-CPC) remains in effect, as moderate El Niño conditions continued to dominate the equatorial Pacific Ocean this past month. Sea surface temperatures (SSTs) were generally 1.5 degrees Celsius above-average across the basin with a hot-spot slightly above 2 degrees C just east of the International Date Line. The International Research Institute for Climate and Society (IRI) states again this month that the current SST pattern is very favorable for affecting the atmospheric circulation pattern across the Pacific. The Southern Oscillation Index (SOI) remained strongly negative again this month, suggesting the atmosphere is responding to the warm ocean temperatures (Figure 13a). The strong atmospheric connection has created classic El Niño weather across the western U.S. characterized by above-average precipitation across the Southwest and unusually dry conditions in the Pacific Northwest.

March is the time of year when El Niño events typically wane and either dissipate or persist for up to two subsequent months. It seems most likely that El Niño conditions will persist at least through April, and given that subsurface temperatures are still anomalously warm, this El Niño may endure through early or middle May. Forecasts from the IRI show an 85 percent chance that El Niño conditions will continue through the March–May period (Figure 13b). This quickly drops to 50 percent in the April–June period when the chance of the return to ENSO-neutral conditions rises to 45 percent. Nonetheless, the impacts of El Niño will most likely continue to be felt across the Southwest over the next month or two, with an increased chance of above-average precipitation. A lingering El Niño event could also impact the timing and intensity of early monsoon rains.

Notes:

The first figure shows the standardized three month running average values of the Southern Oscillation Index (SOI) from March 1980 through December 2009. 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.

The second figure 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–February 2010. 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).

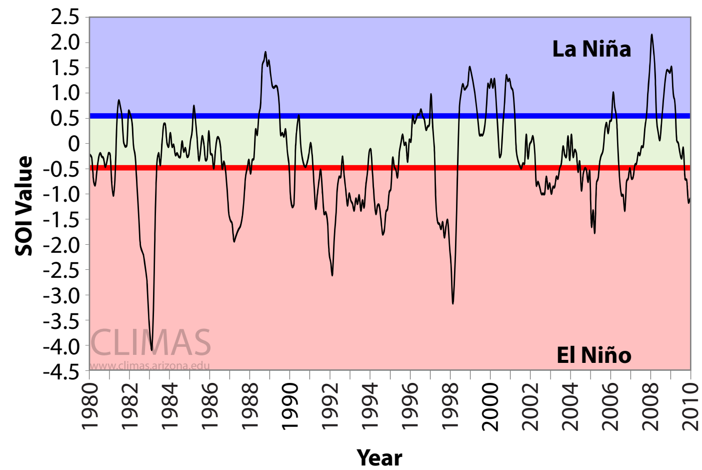
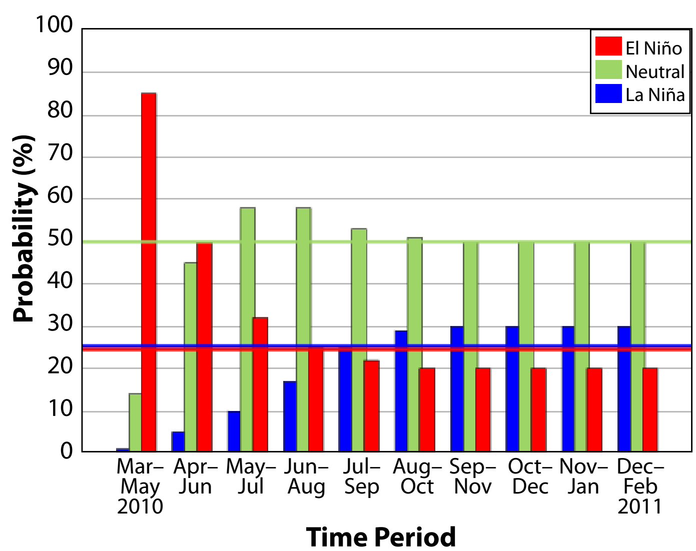


Figure 13b. IRI probabilistic ENSO forecast for El Niño 3.4 monitoring region (released March 18). Colored lines represent average historical probability of El Niño, La Niña, and neutral.



Temperature Verification
(April–September 2010)

Source: Forecast Evaluation Tool

For a thorough description of the interpretation of these maps, see the feature article, "Evaluating forecasts with the RPSS," in the April 2009 issue of the Southwest Climate Outlook.

Comparisons of observed temperature for April–June to forecasts issued in March for the same period suggest that in southern Arizona and New Mexico forecasts are slightly better than forecasting equal chances (Figure 14a). Forecast skill—a measure of the accuracy of the forecast—is highest in the southeast corner of Arizona. Skill for the two-month lead time forecasts historically have been more accurate than equal chances in all of Arizona and New Mexico (Figure 14b). The three- and four-month lead time forecasts historically have been more accurate than equal chances in all of Arizona outside the Four Corners region (Figures 14c–d). In New Mexico, however, the three- and four-month lead time forecasts have been less accurate than equal chances. Caution is advised to users of the seasonal forecasts for regions with reddish colors.

Notes:

These maps evaluate the historical performance of the one- to four-month long-lead forecasts made by NOAA's Climate Prediction Center (CPC). The maps convey the historical accuracy of the CPC forecasts in relation to the reference forecast, which assigns a 33 percent chance to the three CPC categories, "above," "below," and "neutral." These categories indicate whether conditions are predicted to be similar to the warmest, coolest, or normal temperatures for 1971 to 2000. The maps are generated from the Forecast Evaluation Tool, which was developed by The University of Arizona in partnership with NOAA, NASA, NSF, and the University of California-Irvine.

The maps display the Ranked Probability Skill Score (RPSS). The more the forecasts and actual weather match, the bluer the color. A bluish or reddish RPSS indicates the forecast is more accurate or less accurate, respectively, than assigning a 33 percent chance to each of the three CPC categories.

The RPSS is calculated by comparing all the forecasts made since December 1994 for particular seasons and specified lead times to the actual weather of the season.

Figure 14a. RPSS for April–June 2010.

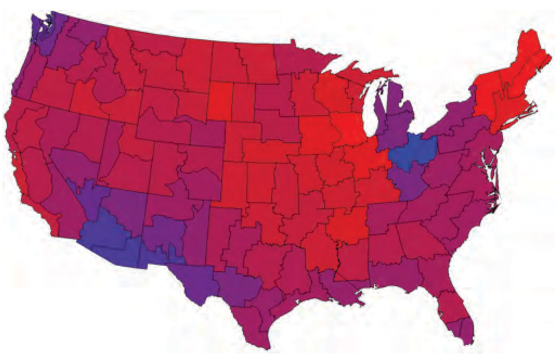


Figure 14b. RPSS for May–July 2010.

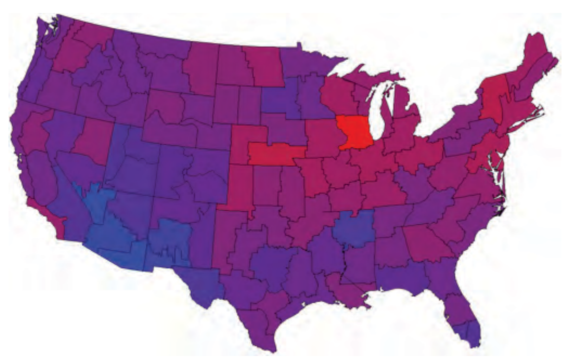


Figure 14c. RPSS for June–August 2010.

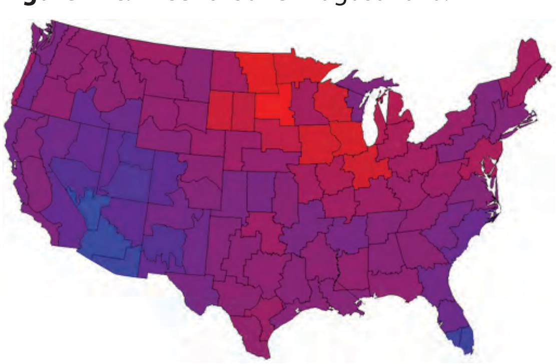
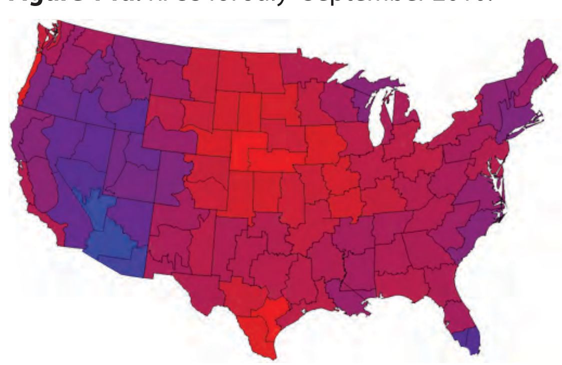
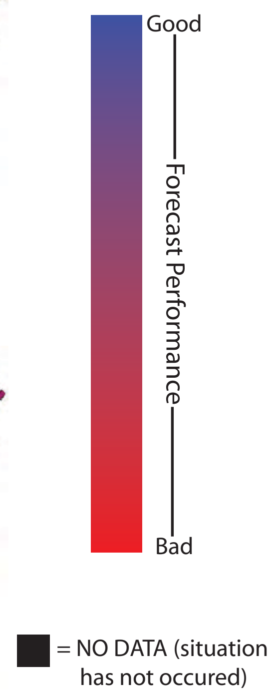


Figure 14d. RPSS for July–September 2010.





On the Web:

For more information on the Forecast Evaluation Tool, visit
http://fet.hwr.arizona.edu/ForecastEvaluationTool/

For a CLIMAS publication that explains how to use the Forecast Evaluation Tool, visit
http://www.climas.arizona.edu/forecasts/articles/FET_Nov2005.pdf

Precipitation Verification
(April–September 2010)

Source: Forecast Evaluation Tool

For a thorough description of the interpretation of these maps, see the feature article, "Evaluating forecasts with the RPSS," in the April 2009 issue of the Southwest Climate Outlook.

Comparisons of observed precipitation for April–June to forecasts issued in March for the same period suggest that forecasts are slightly better than forecasting equal chances in northern Arizona and New Mexico, while forecasts have been worse than equal chances in the southern regions of both states (Figure 15a). Forecast skill—a measure of the accuracy of the forecast—is highest in the northwest corner of Arizona, but only marginally better than equal chances. Skill for the two-month lead time forecasts historically have been more accurate than equal chances in southern Arizona; most of the rest of the Southwest forecasts have not been more accurate than equal chances (Figure 15b). The three-month lead time forecast has not performed better than equal chances and the four-month lead time forecast historically has been less accurate than equal chances in all of New Mexico and most of Arizona (Figures 15c–d). Bluish hues suggest that NOAA–CPC historical forecasts have been more accurate than equal chances. However, caution is advised to users of the seasonal forecasts for regions with reddish colors.

Notes:

These maps evaluate the historical performance of the one- to four-month long-lead forecasts made by NOAA's Climate Prediction Center (CPC). The maps convey the historical accuracy of the CPC forecasts in relation to the reference forecast, which assigns a 33 percent chance to the three CPC categories, "above," "below," and "neutral." These categories indicate whether conditions are predicted to be similar to the wettest, driest, or normal precipitation for 1971 to 2000. The maps are generated from the Forecast Evaluation Tool, which was developed by The University of Arizona in partnership with NOAA, NASA, NSF, and the University of California-Irvine.

The maps display the Ranked Probability Skill Score (RPSS). The more the forecasts and actual weather match, the bluer the color. A bluish or reddish RPSS indicates the forecast is more accurate or less accurate, respectively, than assigning a 33 percent chance to each of the three CPC categories.

The RPSS is calculated by comparing all the forecasts made since December 1994 for particular seasons and specified lead times to the actual weather of the season.

Figure 15a. RPSS for April–June 2010.

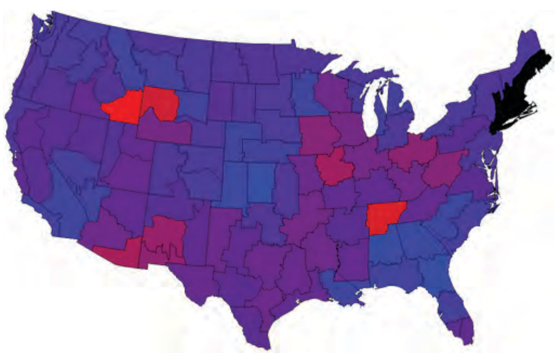
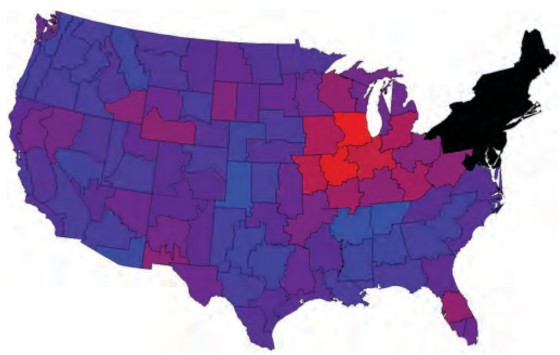


Figure 15b. RPSS for May–July 2010.



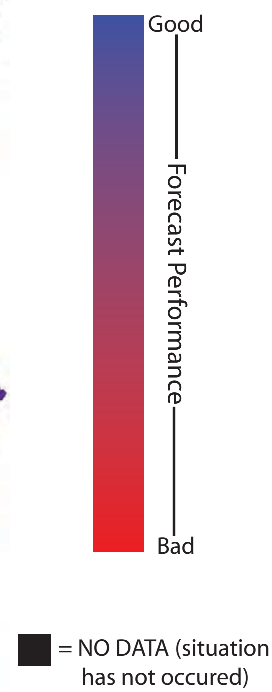


Figure 15c. RPSS for June–August 2010.

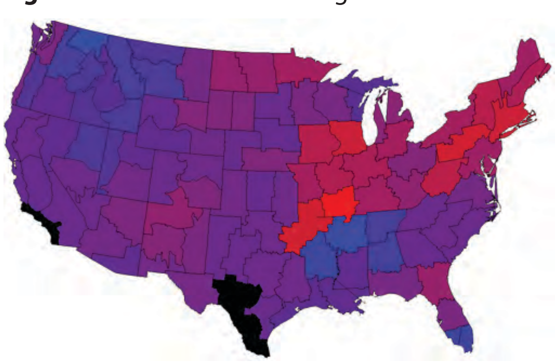
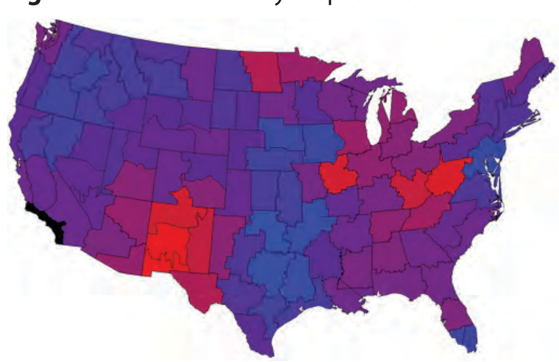


Figure 15d. RPSS for July–September 2010.



On the Web:

For more information on the Forecast Evaluation Tool, visit http://fet.hwr.arizona.edu/ForecastEvaluationTool/

For a CLIMAS publication that explains how to use the Forecast Evaluation Tool, visit http://www.climas.arizona.edu/forecasts/articles/FET_Nov2005.pdf