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Southwest Climate Outlook

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A hummingbird laps cactus nectar near the Rincon Mountains in southern Arizona. The deserts and high country in the Southwest are aflutter with flowers and pollinators, even after a dry winter. *Photo source: Holly Lawson*

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: zguido@email.arizona.edu

In this issue...

April Climate Summary

Drought: Moderate or more severe drought covers most of Arizona and New Mexico. Central and southern Arizona and eastern New Mexico are the only areas in the West classified with extreme or exceptional drought.

Temperature: Temperatures across most of the Southwest in the last 30 days were 2 to 6 degrees F warmer than average.

Precipitation: Precipitation in most of Arizona and southern and western New Mexico measured less than 50 percent of average in the last 30 days, continuing a dry stretch that began around January 1.

ENSO: The La Niña event is transiting to ENSO-neutral conditions; neutral conditions are expected to persist through the May–July. Signs of a developing El Niño are on the horizon.

Climate Forecasts: Forecasts call for above-average temperatures through the monsoon. Precipitation forecasts, however, are less definitive, as monsoon forecasts historically have been about as accurate as a coin flip.

The Bottom Line: Had it not been for the cavalcade of storms that drenched many parts of Arizona and New Mexico in December 2011, precipitation deficits would be much higher across the Southwest. Since January 1, rain and snow have measured less than 50 percent of average across the region, and it has been similarly dry in the Upper Colorado River and Rio Grande basins. In these regions, snowpacks are below average and most stations report that the water contained in snowpacks is less than 50 percent of average. The scant snow this winter is feeding low spring streamflow projections across the region. Inflow into Lake Powell, for example, is expected to be 3.5 million acre-feet less than average, or 44 percent of average. Relief from expanding and intensifying drought may not come until the monsoon begins this summer, but it is unclear when the monsoon will begin in earnest or how much rain it will deliver. Although monsoon forecasts are not definitive, there is higher confidence that temperatures will be above average in coming months, in part because summer months have become progressively warmer in recent decades.

Setting the stage for continual assessments of the Colorado River Basin

A report published by CLIMAS and its partners suggests ways for conducting ongoing assessments of climate impacts and adaptation in the Colorado River Basin (CRB).

The CRB is perhaps the most crucial resource in the Southwest, providing water to about 30 million people in seven U.S. states and Mexico. Managing the river sustainably in a changing social and climate landscape is no small task, requiring ongoing vigilance and collaboration by many stakeholders over many years. Given its importance, researchers, managers, and other stakeholders convened in Boulder, Colo., in June 2011 to discuss creating a coordinated network for ongoing assessment and adaptation. Those discussions were synthesized in the report, "Evaluating Our Capacity: A discussion of capability for ongoing climate assessment in the Colorado River Basin."

Among numerous conclusions, the report states that forming communities of practice that share lessons learned, data, and project information will facilitate assessment. Effective, continuous assessments will also require closer collaboration among stakeholders and researchers and stronger leadership and willingness to act than currently emplaced, the report states.

For more information, visit: http://www.climas.arizona.edu/publications/2375

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SWCO Staff:

This work is published by the Climate Assessment for the Southwest (CLIMAS) project, the University of Arizona Cooperative Extension, and the Arizona State Climate Office.

Cinnamon Snow: Flecks of Dust Alter Western Water Supplies

By Zack Guido

Fierce winds whipped across the Colorado Plateau on March 18, raking plumes of dust into the air. Hundreds of miles to the northeast, the winds scoured the San Juan Mountains at 60 miles per hour, scattering flecks of red and brown earth across the white snow. Farther north, in Boulder, Colo., air quality plummeted.

Walls of dust unleashed by such blustery spring conditions can sling sand and silt from the Four Corners region hundreds of miles, ultimately sprinkling snow in the Upper Colorado River Basin with a cinnamon-colored coat that soaks up sun rays. These dirty snowpacks can significantly affect water resources in the Southwest; they often cause earlier snowmelt that hastens the timing of peak streamflows and can send gushing torrents down alpine creeks. Moreover, recent research suggests that dust layers reduce the amount of water available to about 30 million people in the U.S. and Mexico who rely on the Colorado River.

With the likely specter of increasing temperatures and fewer winter storms, dust events may become more common in the future and stress the region's already limited water supply. But there is also a silver lining: minimizing dust mobility may help put water back into the river.

Figure 1. Fierce winds on May 11, 2009, painted the Upper Colorado River Basin, including the Elk Mountains near Aspen, Colo., with brown dust. Photo credit: Jack Brauer, WideRange Photo LLC

Albedo

The sun incessantly beats down on the Southwest. About 1,100 watts of energy hit the landscape at midday in southern Colorado every second, for example, creating enough energy, if it accumulated over three hours, to power the average U.S. house for an entire year. A fraction of this energy is absorbed by earthen materials that, in turn, give off heat. Part of the energy, however, is also reflected back to space. The reflectivity of an object is known as albedo; the higher the albedo, the more reflectance.

Darker objects have lower albedos. Deserts reflect about 30 percent, forests 20 percent, and asphalt only about 10 percent. Because cities are laced with low-albedo materials like asphalt, they tend to be warmer than pristine spaces, creating what is known as the urban heat island effect.

On average, Earth's albedo is about 0.3, reflecting 30 percent of the incoming solar radiation back to space, but the amount differs considerably across landscapes. The highest albedo of any naturally occurring surface is clean snow. The glistening surface reflects about three-quarters of the solar radiation that hits it. Snow mottled in dust reduces the albedo of fresh snow to about 45 percent, turning a highly reflective surface into a landscape that absorbs 30–70 watts more energy. Dust is like sprinkling small heat rods into the snowpack.

"Dust is a massive conduit of energy into snowpack," said Thomas Painter, a research scientist at the California Institute of Technology's Jet Propulsion Laboratory. "For clean snow to absorb the same amount of energy as dirty snow, the earth would have to be closer to the sun than Venus."

Increased energy not only melts the snow, but it also enlarges individual snow crystals. Larger crystals allow sunlight to penetrate further into the snowpack, increasing its chances of eventually striking dust and further warming the snowpack. The presence of dust often increases the temperature of snowpacks by 3–7 degrees Celsius (roughly 5–13 degrees Fahrenheit).

continued on page 4

Cinnamon Snow, continued

Dust Events

Since 2003, researchers have monitored the number of times visible dust layers have been deposited in southern Colorado's San Juan Mountains. In the last 10 years, the mountains have been coated with dust about eight times per year, on average. In 2009, a record 12 dust layers accumulated. Most layers are deposited in April and May, when persistent winds in the Southwest sweep across many sparsely vegetated areas.

"There are hundreds, even thousands of dust sources, and much of it comes from northeast Arizona and southwest New Mexico," said Richard Reynolds, a research scientist at the U.S. Geological Survey in Denver. "Many settings in the Little Colorado River drainage basin, but not the river bottom itself, and in Chuska Valley are particularly important source areas."

These regions become even more prone to exporting dust when dry times reign and vegetation cover wanes. Dry weather has been the norm so far in 2012, and most of the Four Corners region has received less than 50 percent of average rain and snow since January 1. As of April 16, eight dust events have occurred, and the withering landscape is primed to give up more dust.

"It's been a very dry year," Painter said. "We are on par with 2009, which was a huge year for dust-on-snow events."

The Four Corners region is aptly suited as a dust source because it is sparsely vegetated and sits in the path of spring storms. It also happens to be situated upwind of many high Rocky Mountain peaks, including the San Juan Mountains, that can act like windbreaks and cause millions of wafting particles to settle.

Dust events have occurred in the region for thousands of years.

"There are aeolian [wind transported] deposits that predate human settlement," Reynolds said. "It's been dry and windy for a long time."

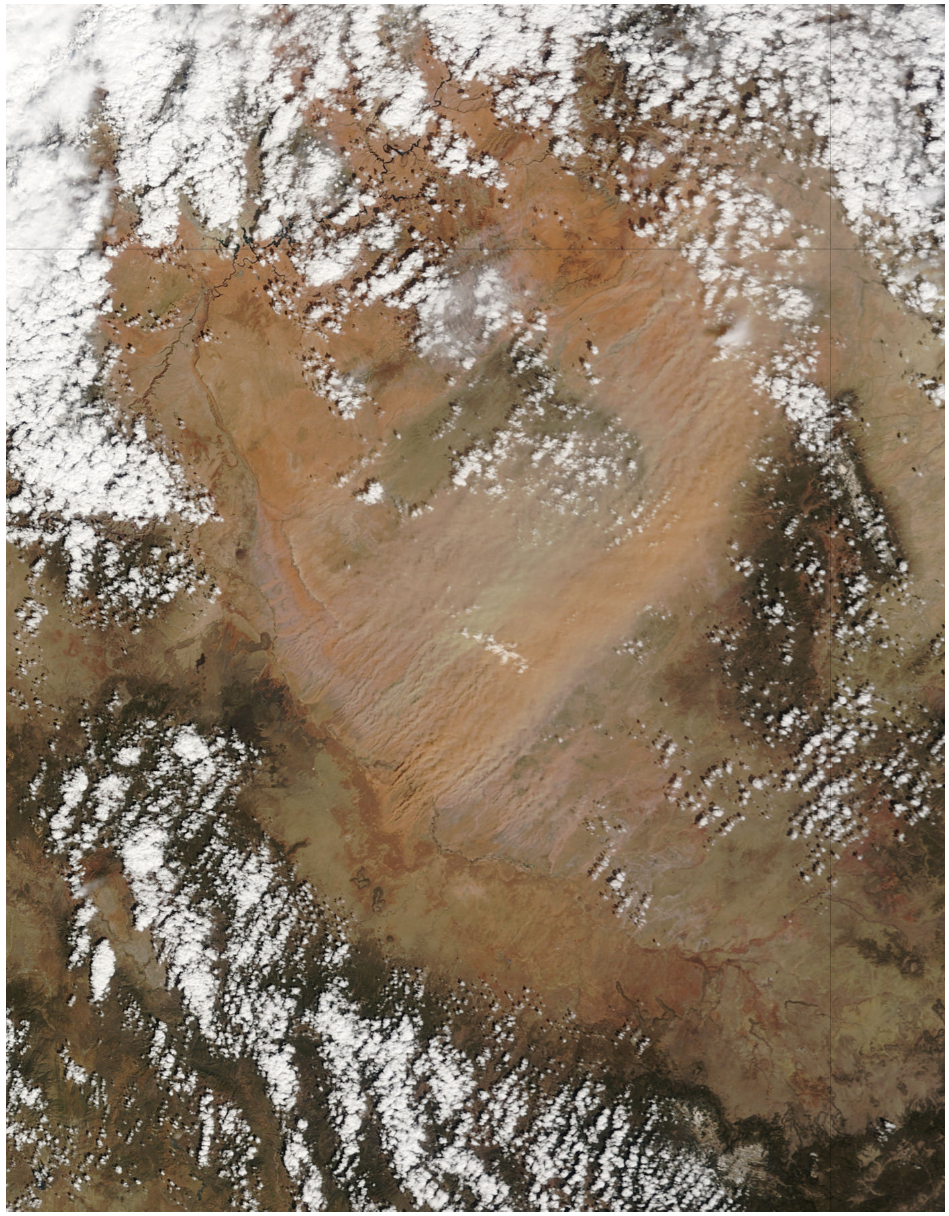

Figure 2. Winds topping 90 miles per hour hurtled across the Four Corners region on April 3, 2009, whipping plumes of dust from Arizona's Painted Desert (shown in the image) to the snow-clad Rocky Mountains. The satellite image was taken by NASA's Terra satellite. Image courtesy of NASA's Earth Observatory

Western settlement, however, has played a recent role in the dust accumulations. Research documents that as population growth accelerated around 1850, grazing, agriculture, and resource exploration that accompanied development disturbed soil surfaces in the Colorado Plateau. Records from lake cores indicate dust accumulation in the Upper Colorado River Basin increased by about 600 percent in the early 20th century, and it remains well above presettlement values today.

The larger dust accumulations and the added heat the layers absorb have altered western water resources in significant ways.

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Impacts on Water Resources

About 7.5 million acre-feet (MAF) of water in the Colorado River flows through Wyoming, Colorado, Utah, and New Mexico every year. Another 7.5 MAF provides much needed water to Arizona, Nevada, and California. Mexico's cut is 1.5 MAF. Added up, the river's current allocation is 12 percent more than the amount that historically flows in the river. Dust, as it turns out, is substantially helping to push the Colorado balance sheet into the red.

"There's a loss of about 5 percent of total runoff in the Colorado River," Painter said, referencing a recent study he co-authored that compared the effects of dust on streamflows before and after land use changes increased dust emissions from the Colorado Plateau.

A runoff reduction of 5 percent is equivalent to twice the annual consumption of Las Vegas, about 18 months of supply to Los Angeles, or about half a year's allocation to Mexico. Painter's research quantified the range of annual streamflow reductions attributed to dust to be between 2.3 and 7.6 percent.

Elevated temperatures in snowpacks are the root cause for lower flows. Higher snowpack temperatures enable more snow to directly evaporate—a process known as sublimation—which then enables winds to ferry that vapor outside the Colorado River Basin.

Dust also helps hasten spring melt, causing the duration of snow cover to shorten by four to five weeks, compared to dust concentrations prior to 1850. In turn, this enables plants to soak up soil moisture sooner and increases evaporation, both of which sap additional water from the system that would otherwise be stored in Lakes Mead and Powell, the two largest reservoirs on the Colorado River. The earlier snowmelt also lengthens the fire season by helping to dry out fire fuels, and it precipitates stream and river torrents, presenting challenges to water managers.

"We live in a more tense world for water management," Painter said. If managers store too much water, they might not be able to release it fast enough during accelerated snowmelt, which would potentially cause flooding.

Since dust emissions skyrocketed before monitoring the Colorado River began in the late 1800s, dust events of recent years likely do not alter the historical average flow. If the number of events rises, however, less water will likely be available for future use.

In a Changing Climate…

Temperatures have risen across the West in recent decades, causing an earlier onset of snowmelt in many western mountains. Numerous studies have linked higher temperatures to increasing aridity, citing the enhanced ability of warmer air to draw moisture from the landscape. Climate projections are unanimous that temperatures will continue to rise, likely resulting in decreased soil moisture and plant cover in many dust-source regions. Drier conditions are also expected to increase fire potential, which would leave soils more exposed to wind erosion. At first glance, the frequency and magnitude of dust events are set to increase.

"A lot of climate models anticipate drying in the Southwest," Reynolds said. "Given this, and the continued disturbance of landscapes, we can probably expect more dust-on-snow events in the future."

More research is needed to confirm the impact dust on snow has on snowpacks and streamflow demonstrated by Painter's research. If results stand the test of time, a reduction of dust loading on mountain snow would then become an attractive strategy to prolong snow cover, reduce runoff rates, and possibly increase total runoff in the Colorado River Basin and beyond.

"If we can anticipate droughts, we can perhaps anticipate how much dust and from where, and better manage our water resources," Reynolds said.

This issue is not just a concern for the Colorado River Basin. The Sierra Nevada in California and the Big Horn range in Wyoming also are drizzled in dust.

The lofty Himalayan peaks, which provide water to hundreds of millions of people, have experienced a 250–400 percent increase in dust compared to before the 1850s. The Aral Sea, which began to dry up in the 1960s after river water was diverted for agricultural purposes, has also become a source of dust for the Hindu Kush, the mountain range stretching between central Afghanistan and northern Pakistan.

The rugged, remote locations of many of these regions, and the costs associated with observing dust events, makes monitoring challenging. However, Painter and his research team are developing methods to monitor dust from space, which will ultimately advance understanding and facilitate the provision of important information to water managers.

"We're still so limited in our knowledge. But we're working as hard as we can—nights, mornings, and weekends—to develop remote sensing technologies and in situ technologies," Painter said.

Temperature (through 4/18/12)

Data Source: High Plains Regional Climate Center

Temperatures since the water year began on October 1 have averaged between 35 and 50 degrees Fahrenheit on the Colorado Plateau of Arizona and across the northwestern half of New Mexico (*Figure 1a*). Temperatures have been colder in the highest elevations in northern New Mexico and eastern Arizona, ranging between 25 and 35 degrees F. In the southwest deserts of Arizona, temperatures have been 50–65 degrees F. These temperatures are within 1 degree F of average across most of Arizona and within 2 degrees F of average in most of New Mexico (*Figure 1b*). The warmest conditions have been in eastern New Mexico. Near-average temperatures across the region since October 1 mask considerable week-to-week variability caused by numerous storms. While many of these storms did not produce precipitation, they did lower temperatures. In the longer interim periods between storms, temperatures were generally above average.

The Southwest was substantially warmer than average in the last 30 days, with an increasing temperature gradient from west to east (*Figures 1c–d*). Temperatures in eastern New Mexico, for example, were between 4 and 8 degrees F warmer than average, while temperatures in western New Mexico and northeastern Arizona were 2–6 degrees F warmer than average. This colder-to-warmer pattern emerged as several cold fronts moved across the region, slightly warming as they advanced east. These are the same storms that, after exiting the Southwest, intersected warm moist air from the Gulf of Mexico and generated severe thunderstorms and tornados over the Great Plains and upper Midwest.

Notes:

The water year begins on October 1 and ends on September 30 of the following year. As of October 1, 2011, we are in the 2012 Water 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 2011 (October 1 through April 18) average temperature.

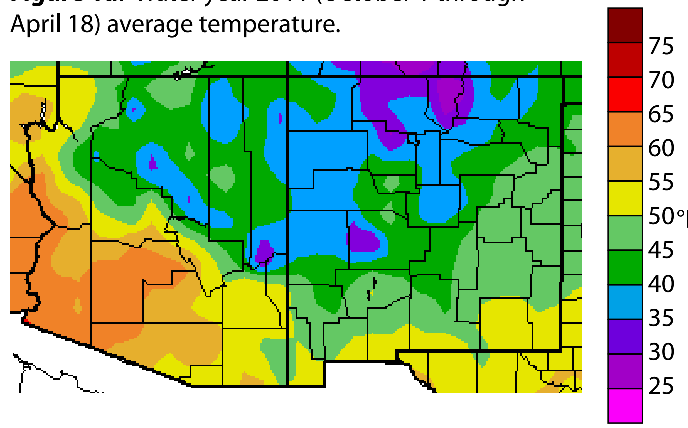


Figure 1b. Water year 2011 (October 1 through April 18) departure from average temperature.

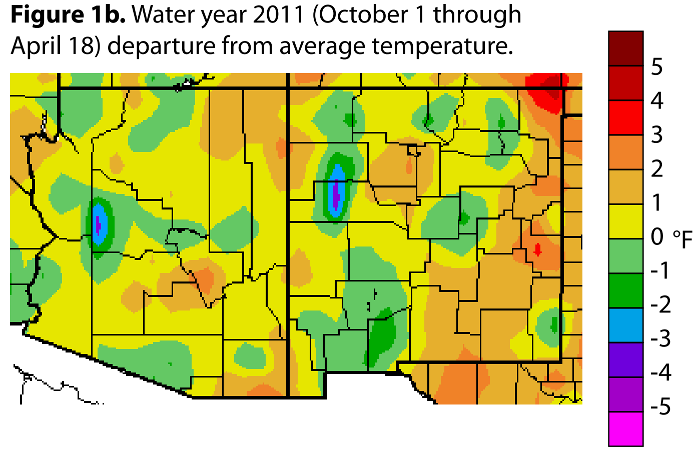


Figure 1c. Previous 30 days (March 20–April 18) departure from average temperature (interpolated).

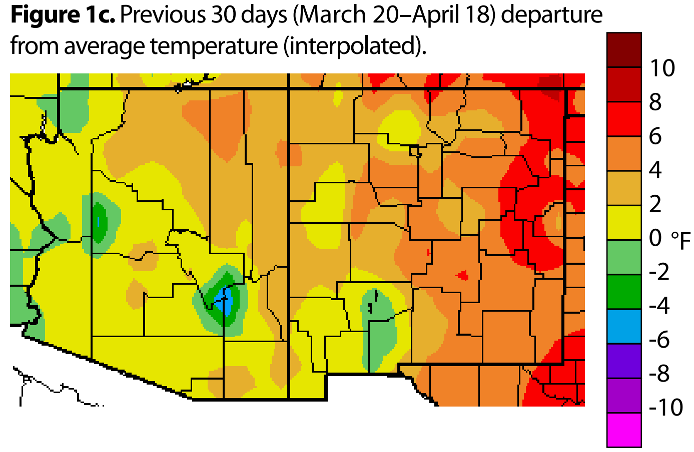
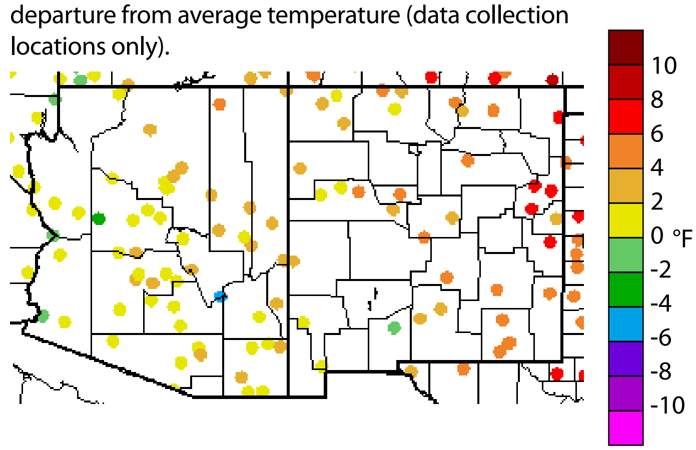


Figure 1d. Previous 30 days (March 20–April 18) departure from average temperature (data collection locations only).



Precipitation (through 4/18/12)

Data Source: High Plains Regional Climate Center

Precipitation since the water year began on October 1 has been well below average across the Southwest for a third consecutive month. Since the end of December, winter storms that brought precipitation to the region have been few and far between; several events that ferried moisture slightly missed the Southwest, either passing to the north or to the south of the region. Since October 1, only the west-central counties of New Mexico have been wetter than average, with rain and snow measuring more than 200 percent of average in places; the wettest conditions have been in Cibola County (*Figure 2a–b*). Outside of this wet spot, most of New Mexico has received 50–90 percent of average precipitation. There have been only a few wetter-than-average conditions in Arizona. Several parts of the state have received less than 50 percent of average. The Upper Colorado River Basin, from which most of the streamflow in the Colorado River originates, also has experienced below-average rain and snow since October 1.

Since March 20, one storm moved through the region and dropped significant rainfall in northwestern Arizona and west-central New Mexico, pushing totals for the last 30 days above average in parts of these regions (*Figures 2c–d*). The rest of Arizona and New Mexico, however, have received less than 75 percent of average precipitation, with many areas measuring less than 5 percent of average.

Notes:

The water year begins on October 1 and ends on September 30 of the following year. As of October 1, 2011, we are in the 2012 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 2011 (October 1 through April 18) percent of average precipitation (interpolated).

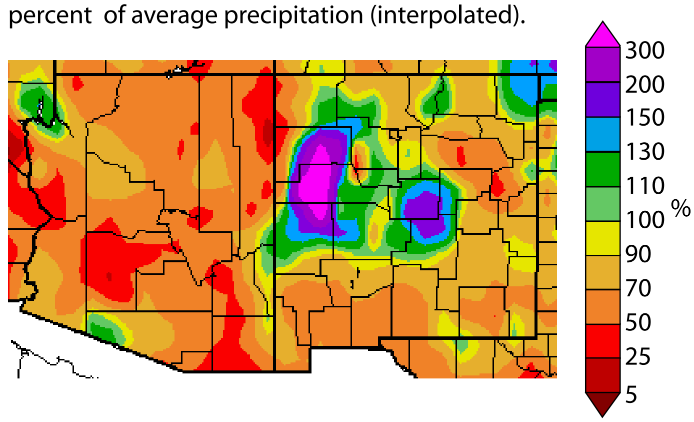


Figure 2b. Water year 2011 (October 1 through April 18) percent of average precipitation (data collection locations only).

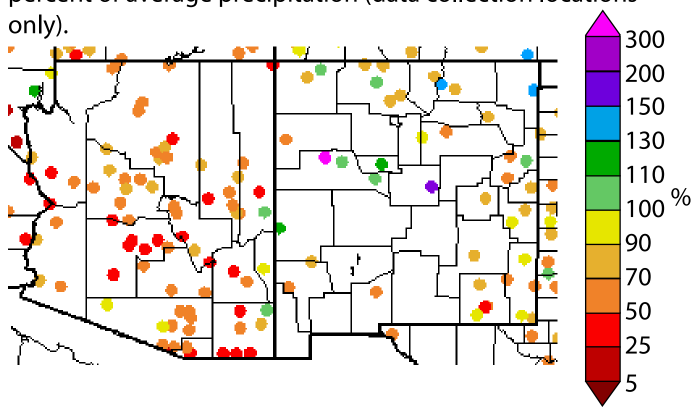


Figure 2c. Previous 30 days (March 20–April 18) percent of average precipitation (interpolated).

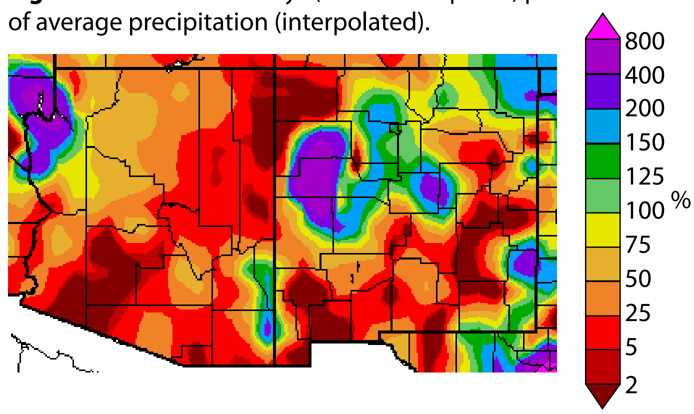
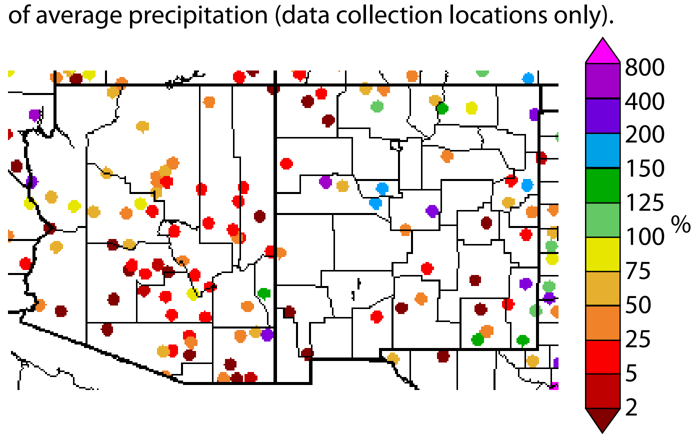


Figure 2d. Previous 30 days (March 20–April 18) percent of average precipitation (data collection locations only).



U.S. Drought Monitor (data through 4/17/12)

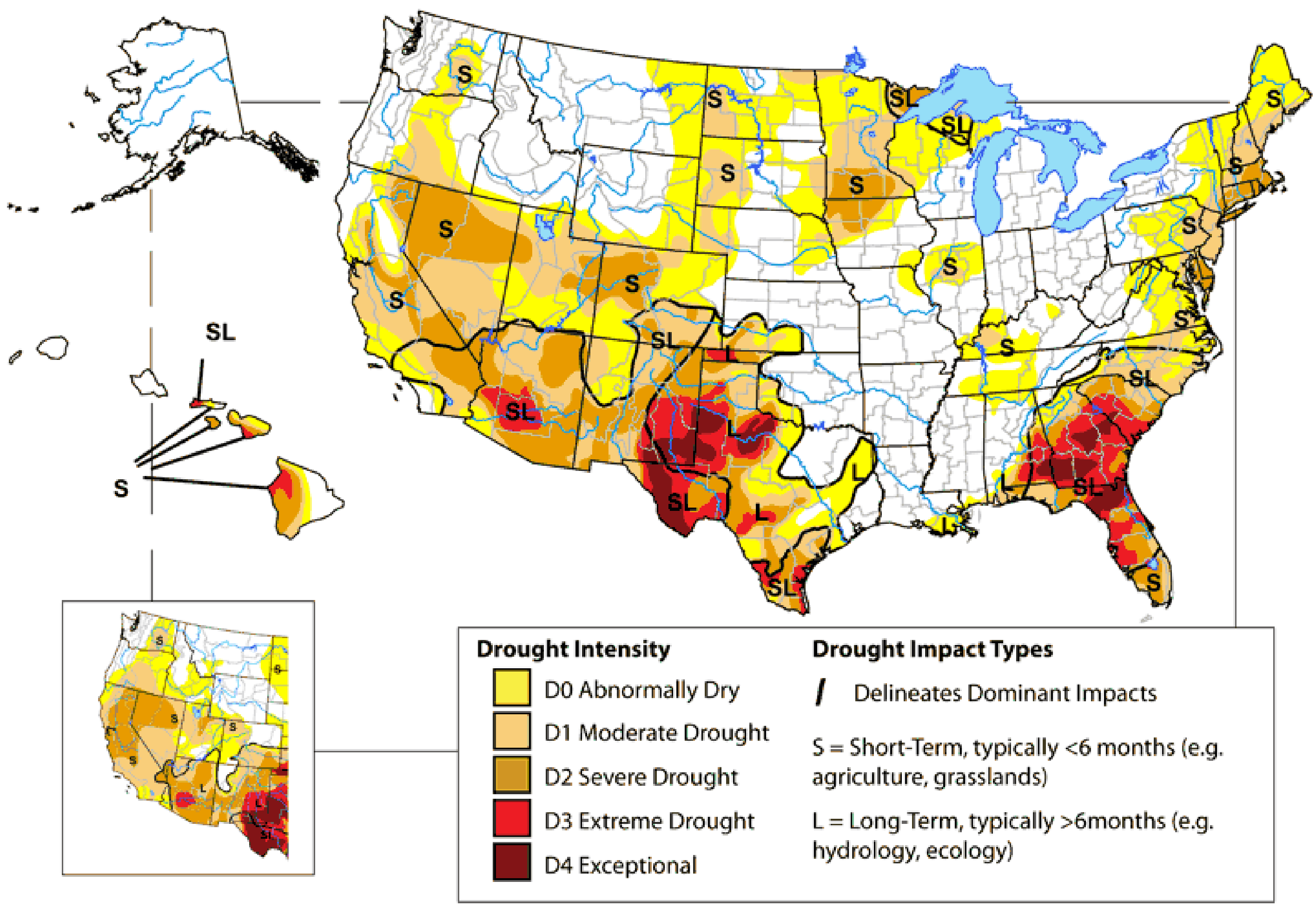
Data Sources: U.S. Department of Agriculture, National Drought Mitigation Center, National Oceanic and Atmospheric Administration

Drought expanded and intensified in parts of Colorado, Utah, and northern New Mexico during the past 30 days. Most of Arizona, New Mexico, and Nevada are experiencing moderate drought or a more severe drought category, and Arizona and New Mexico are home to the only extreme or exceptional drought conditions in the West. The only drought-free areas in the western U.S. are located across the Pacific Northwest and northern Rockies, where above-average precipitation has fallen in recent months as a result of the position of the westerly storm track. Wetter-than-average weather in these regions historically occurs during La Niña events. Most of the Southwest and central and southern Rockies have been dry this winter, particularly since January 1, which is also the norm in La Niña winters.

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.

Figure 3. Drought Monitor data through April 17, 2012 (full size), and March 13, 2012 (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.gov/portal/server.pt/community/current_drought/208

Arizona Drought Status

(data through 4/17/12)

Data Source: U.S. Drought Monitor

Moderate drought or more severe drought covers nearly all of Arizona, according to the April 17 update of the U.S. Drought Monitor. In the past 30 days, precipitation in most of Arizona was less than 50 percent of average, which helped propagate expanding and intensifying drought conditions across the state. About 13 percent of the state is currently classified with extreme drought, while another 52 and 31 percent are labeled with severe and moderate drought, respectively (*Figure 4*). The hardest hit areas continue to be central and southern Arizona, where 90-day precipitation totals are only 25 percent of average for this time of the year.

Ongoing drought conditions have prompted the U.S. Department of Agriculture to declare a drought disaster for six Arizona counties: Coconino, Gila, Maricopa, Pima, Pinal, and Yavapai (Businessweek.com, April 9). In these regions, farmers and ranchers can apply for low interest emergency loans from the Farm Services Agency to help recover from losses under this declaration.

Figure 4a. Arizona drought map based on data through April 17.

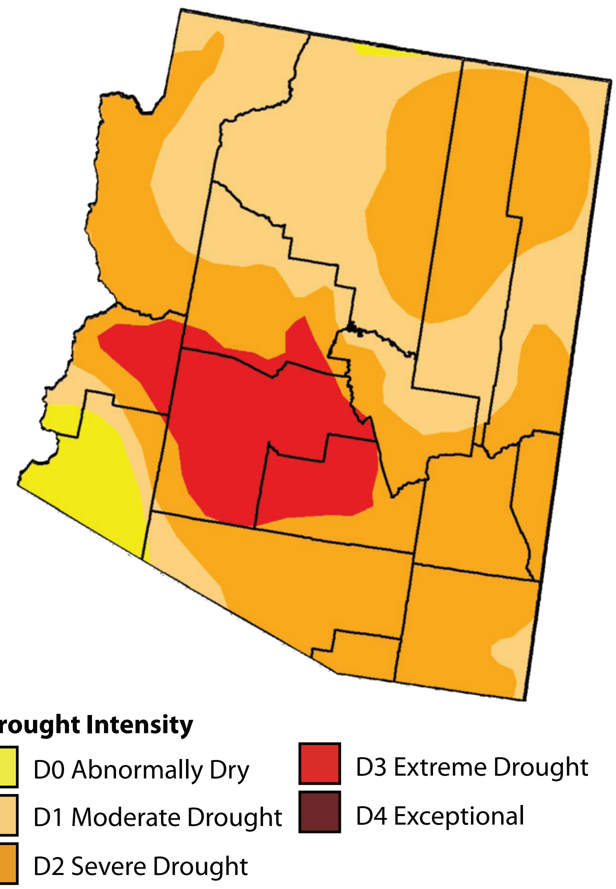


Figure 4b. Percent of Arizona designated with drought conditions based on data through April 17.

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.00	100.00	95.88	64.96	12.61	0.00
Last Week (04/10/2012 map)	0.00	100.00	93.82	62.21	12.61	0.00
3 Months Ago (01/17/2012 map)	7.36	92.64	60.34	36.56	2.78	0.00
Start of Calendar Year (12/27/2011 map)	16.70	83.30	60.34	36.56	2.78	0.00
Start of Water Year (09/27/2011 map)	0.02	99.98	69.76	42.81	15.34	1.67
One Year Ago (04/12/2011 map)	25.62	74.38	49.30	22.16	11.73	0.00

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 4/17/12)

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

Unusually dry late winter and early spring weather during the past 30 days helped expand and intensify drought conditions across New Mexico. Precipitation in most of southern and western New Mexico measured less than 50 percent of average, with many places experiencing no rain or snow. Since January 1, precipitation across the state has been less than 70 percent of average. As a result, about 86 percent of New Mexico is classified with moderate drought conditions or a more severe drought category, an increase from 82 percent in mid-March (*Figure 5*). The largest changes have occurred across northwest New Mexico, where abnormally dry conditions and moderate drought have replaced drought-free conditions. Southeastern New Mexico continues to experience the worst conditions, with extreme and exceptional drought persisting for more than a year.

Figure 5a. New Mexico drought map based on data through April 17.

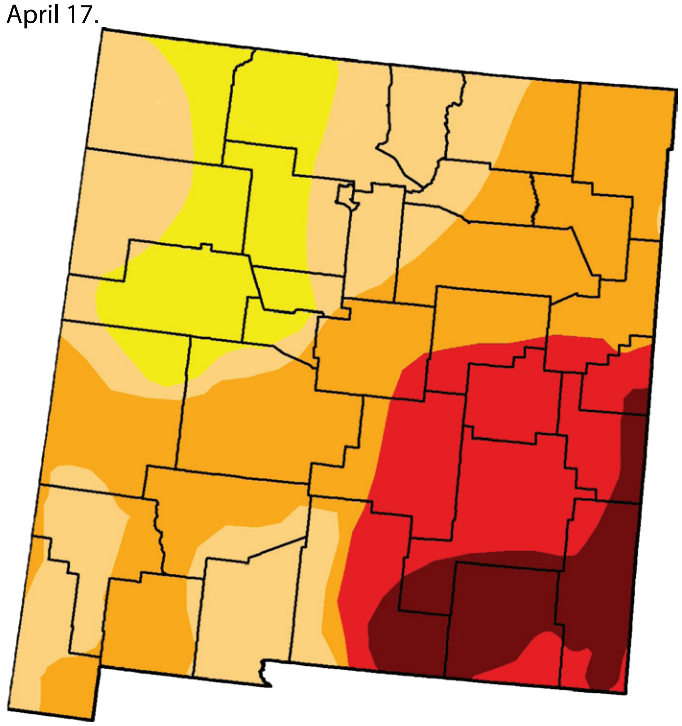


Figure 5b. Percent of New Mexico designated with drought conditions based on data through April 17.

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.00	100.00	86.48	58.54	24.94	8.86
Last Week (04/10/2012 map)	0.00	100.00	80.46	58.60	24.94	9.03
3 Months Ago (01/17/2012 map)	8.63	91.37	87.20	63.73	23.37	7.56
Start of Calendar Year (12/27/2011 map)	8.63	91.37	87.60	72.15	23.37	7.57
Start of Water Year (09/27/2011 map)	0.00	100.00	96.40	88.99	69.61	35.13
One Year Ago (04/12/2011 map)	0.00	100.00	94.42	74.31	29.47	0.00

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 3/31/12)

Data Source: National Water and Climate Center

Combined storage in Lakes Mead and Powell decreased by 334,000 acre-feet in March but is still about 12 percent greater than it was one year ago due to copious winter snow in 2010–2011. The Salt River Basin system, which supplies water to the Phoenix metropolitan area, decreased by about 3,000 acre-feet in March and is 72 percent full, about 6 percent above average for this time of year (*Figure 6*). Reservoirs in the Verde River Basin experienced the largest increase in total storage, rising by 15,000 acre-feet in March, but are still only at 28 percent of capacity. Storage in the San Carlos Reservoir also is very low, at about 3 percent of capacity.

In water-related news, researchers from Arizona and Sonora, Mexico, found increased vulnerability among urban water users throughout the Arizona-Sonora region to climatic changes because of aging or inadequate water-delivery infrastructure, over-allocation of water resources, and the location of poor neighborhoods in flood-prone areas or other areas at risk (UANews.org, April 16).

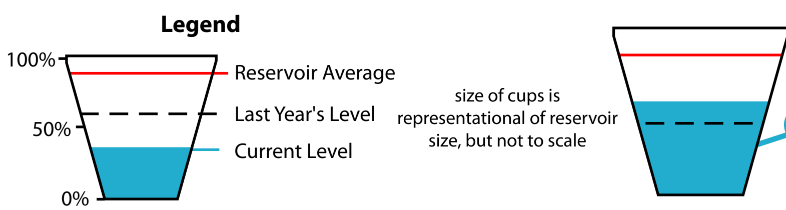
Notes:

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.

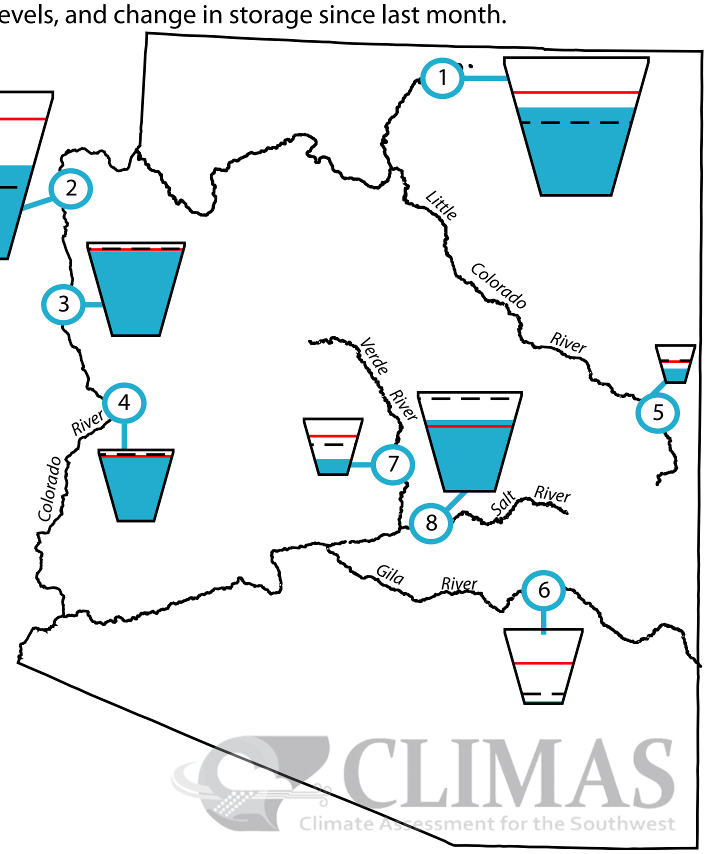
These data are based on reservoir reports updated monthly by the National Water and Climate Center of the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS).

Figure 6. Arizona reservoir levels for March 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	64%	15,465.0	24,322.0	12.0
2. Lake Mead	56%	14,539.0	26,159.0	-368.0
3. Lake Mohave	91%	1,654.1	1,810.0	4.3
4. Lake Havasu	91%	565.0	619.0	2.6
5. Lyman Reservoir	38%	11.3	30.0	1.7
6. San Carlos	3%	24.6	875.0	0.3
7. Verde River System	28%	81.1	287.4	15.7
8. Salt River System	72%	1,455.0	2,025.8	-3.0

*** 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 3/31/12)

Data Source: National Water and Climate Center

Total reservoir storage in New Mexico increased by 70,000 acre-feet in March (*Figure 7*). Storage in New Mexico's largest reservoirs, Elephant Butte and Navajo, is about 386,000 and 1.3 million acre-feet, respectively. Elephant Butte, located on the Rio Grande in central New Mexico, is only 18 percent full and is 3 percent lower than it was one year ago. Storage in Navajo, located on the San Juan River in northwest New Mexico, is 77 percent full, much like it was at this time last year. Most reservoirs in New Mexico experienced an increase in storage in March, which is typical for this time of year.

In water-related news, the latest forecast for inflow into Elephant Butte Reservoir calls for streamflow to be only about 29 percent of average. If the forecast is correct, very little surface water will be available for farmers in the Elephant Butte Irrigation District (*Albuquerque Journal*, April 10). To compensate, farmers will have to pump more groundwater, which supplies saltier water that can reduce crop quality and is more expensive than using Rio Grande water.

Notes:

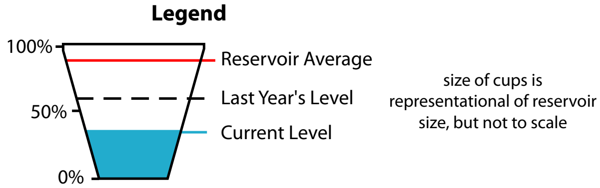
The map gives a representation of current storage levels for reservoirs in New Mexico. Reservoir locations are numbered within the blue circles on the map, corresponding to the reservoirs listed in the table. The cup next to each reservoir shows the current storage level (blue fill) as a percent of total 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 Resources Conservation Service (NRCS).

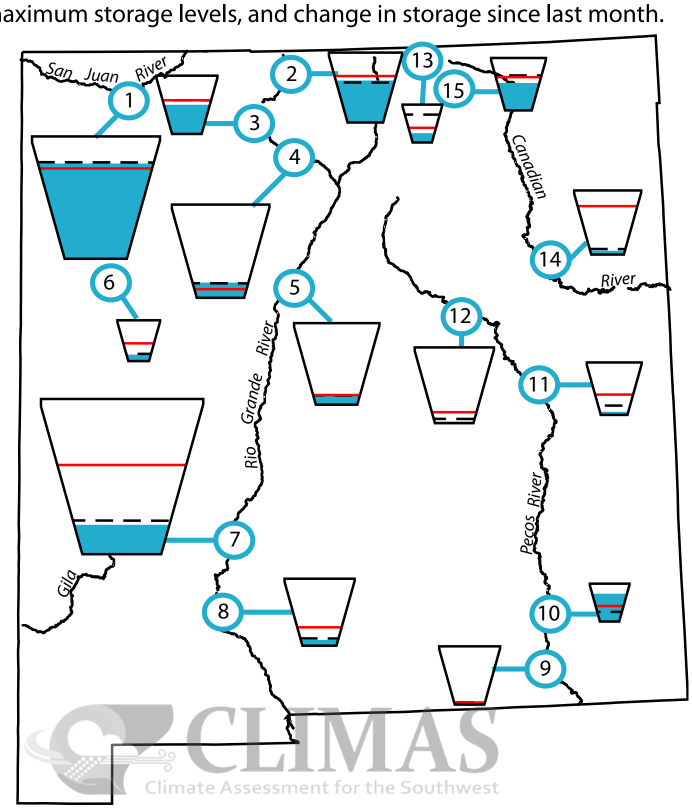
Figure 7. New Mexico reservoir levels for March as a percent of capacity. The map depicts the average level and last year's storage for each reservoir. The table also lists current and maximum storage levels, and change in storage since last month.

Legend



Reservoir Name	Capacity Level	Current Storage*	Max Storage*	Change in Storage*
1. Navajo	77%	1307.8	1,696.0	22.9
2. Heron	59%	234.0	400.0	7.4
3. El Vado	49%	92.9	190.3	6.7
4. Abiquiu	15%	174.8	1,192.8	-0.5
5. Cochiti	10%	51.1	491.0	0.2
6. Bluewater	15%	5.9	38.5	1.2
7. Elephant Butte	18%	385.8	2,195.0	18.8
8. Caballo	8%	26.1	332.0	9.8
9. Brantley	2%	21.6	1,008.2	6.7
10. Lake Avalon	73%	2.9	4.0	0.1
11. Sumner	5%	4.8	102.0	0.2
12. Santa Rosa	1%	6.2	438.3	-3.9
13. Costilla	24%	3.8	16.0	0.6
14. Conchas	5%	12.8	254.2	-1.7
15. Eagle Nest	51%	39.9	79.0	1.1

*** thousands of acre-feet**



On the Web:

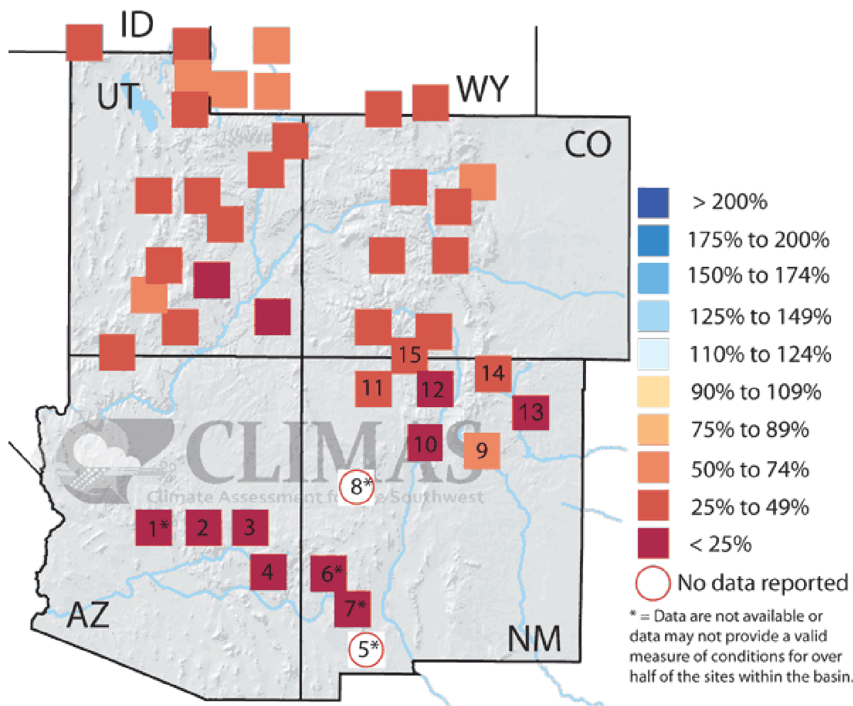
Portions of the information provided in this figure can be accessed at the NRCS website
http://www.wcc.nrcs.usda.gov/wsf/reservoir/resv_rpt.html

Southwest Snowpack
(updated 4/19/12)
Data Sources: National Water and Climate Center, Western Regional Climate Center

Below-average precipitation and warming temperatures across most of the Southwest in the last month have precipitated decreases in the amount of mountain snow. In Arizona, the water contained in snowpacks, or snow water equivalent (SWE), measured by snow telemetry (SNOTEL) stations was less than 15 percent of average in all but the San Francisco Peaks, where SWE was 49 percent of average as of April 19 (*Figure 8*). The Upper Salt River and the Verde River basins measured only 7 and 11 percent of average, respectively, a decline from 40 and 20 percent reported last month.

In New Mexico, all basins reported in Figure 8 had well below-average snowpacks. Whereas most basins reported snowpacks greater than 70 percent of the 1971–2000 average last month, currently all but one basin reported values equal to or less than 45 percent of average. Some basins are reporting no snow, including the San Francisco and the Gila river basins in the southwest corner of the state and the Jemez River Basin in northern New Mexico. The Pecos and Animas river basins reported the highest SWE, measuring 55 and 45 percent, respectively. The below-average snowpacks are in part caused by recent warm temperatures. Temperatures across most of the state ranged from 2 to 6 degrees F above average in the last month.

Figure 8. Average snow water equivalent (SWE) in percent of average for available monitoring sites as of April 19, 2012.



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

All monitoring stations in Colorado and Utah also reported well below-average SWE as of April 19. As a result, streamflow forecasts for the Upper Colorado River Basin are below average; inflow into Lake Powell, for example, has a 50 percent chance of being less than 3.5 million acre-feet, or 44 percent of the historical average, for the April–July period.

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 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
(May–October 2012)
Data Source: NOAA-Climate Prediction Center (CPC)

The seasonal temperature outlooks issued by the NOAA-Climate Prediction Center (CPC) in April call for increased odds that temperatures for the three-month seasons spanning May to October will be similar to the warmest 10 years in the 1981–2010 period (*Figures 9a–d*). For the May–July period, there is a 50 percent chance that temperatures will be 0.8–1.5 degrees F above average in most of Arizona and New Mexico. The highest temperature anomalies likely will be located in northern Arizona. The above-average temperatures for this period partly reflect recent warming trends. The outlooks also forecast more than a 50 percent chance of above-average temperatures in the summer months, also reflecting recent warming trends for the monsoon season. Although the atmosphere is still currently responding to the La Niña event, it is expected to transition into ENSO-neutral conditions in the coming weeks (see page 19). As a result, La Niña no longer influences these temperature outlooks, according to the CPC.

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 1981–2010 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 May–July 2012.

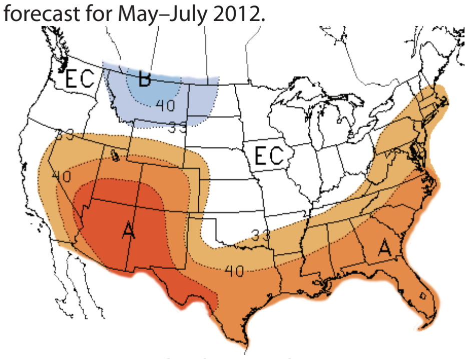


Figure 9b. Long-lead national temperature forecast for June–August 2012.

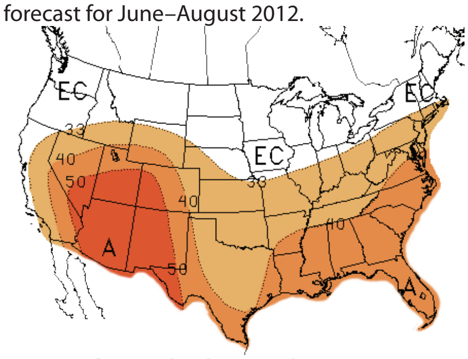


Figure 9c. Long-lead national temperature forecast for July–September 2012.

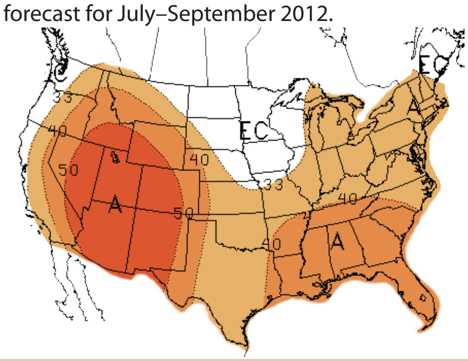
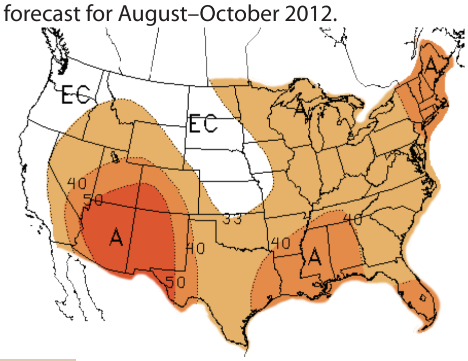


Figure 9d. Long-lead national temperature forecast for August–October 2012.



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

B=Below
40.0–49.9%
33.3–39.9%

EC= Equal chances. No forecasted anomalies.

On the Web:

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

For seasonal temperature forecast downscaled to the local scale, visit http://www.weather.gov/climate/l3mto.php

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

Precipitation Outlook
(May–October 2012)
Data Source: NOAA-Climate Prediction Center (CPC)

The seasonal precipitation outlooks issued by the NOAA-Climate Prediction Center (CPC) in April call for equal chances that precipitation will be above, below, or near average in most of Arizona and New Mexico through the July–September period *(Figures 10a–c)*. For the summer months, forecasts have been less accurate during the monsoon season. Consequently, the CPC has no basis to favor wetter- or drier-than-average conditions and gives an equal chances outlook for the June–August and July–September periods. In the August–October period, odds are slightly increased for below-average rain, most notably in southeastern Arizona (*Figure 10d*). Although not reflected in the official forecasts, studies have demonstrated that dry winters with low snowpack similar to this year often are followed by wet summers. Some studies suggest shorter-lived snow cover enables the land to warm sooner in the summer, which, in turn, instigates incursions of moisture from the Gulfs of California and Mexico that spark monsoon storms.

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 1981–2010 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 May–July 2012.

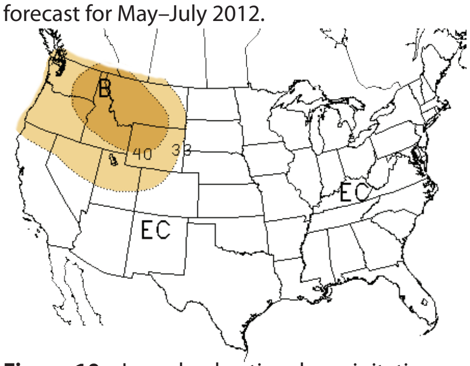
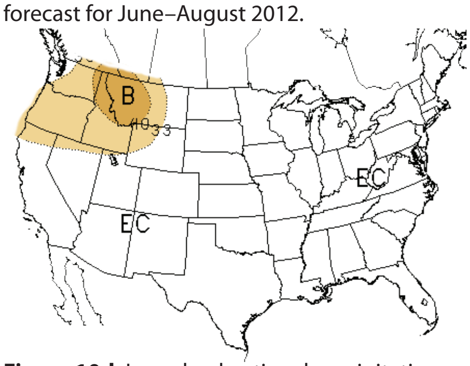


Figure 10b. Long-lead national precipitation forecast for June–August 2012.



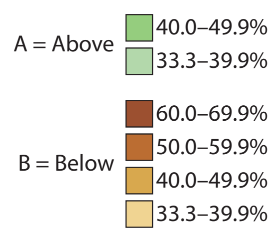


Figure 10c. Long-lead national precipitation forecast for July–September 2012.

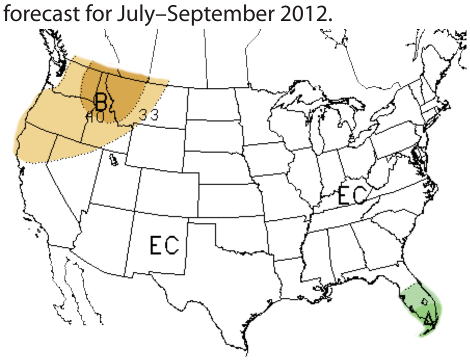
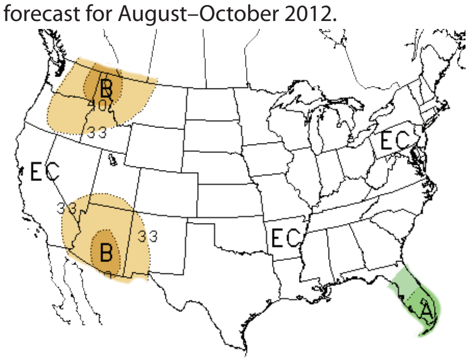


Figure 10d. Long-lead national precipitation forecast for August–October 2012.



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 March load slowly on your computer)

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

Seasonal Drought Outlook
(through July)
Data Source: NOAA–Climate Prediction Center (CPC)

This summary is partially excerpted and edited from the April 19 Seasonal Drought Outlook technical discussion produced by the NOAA-Climate Prediction Center (CPC) and written by forecaster R. Tinker.

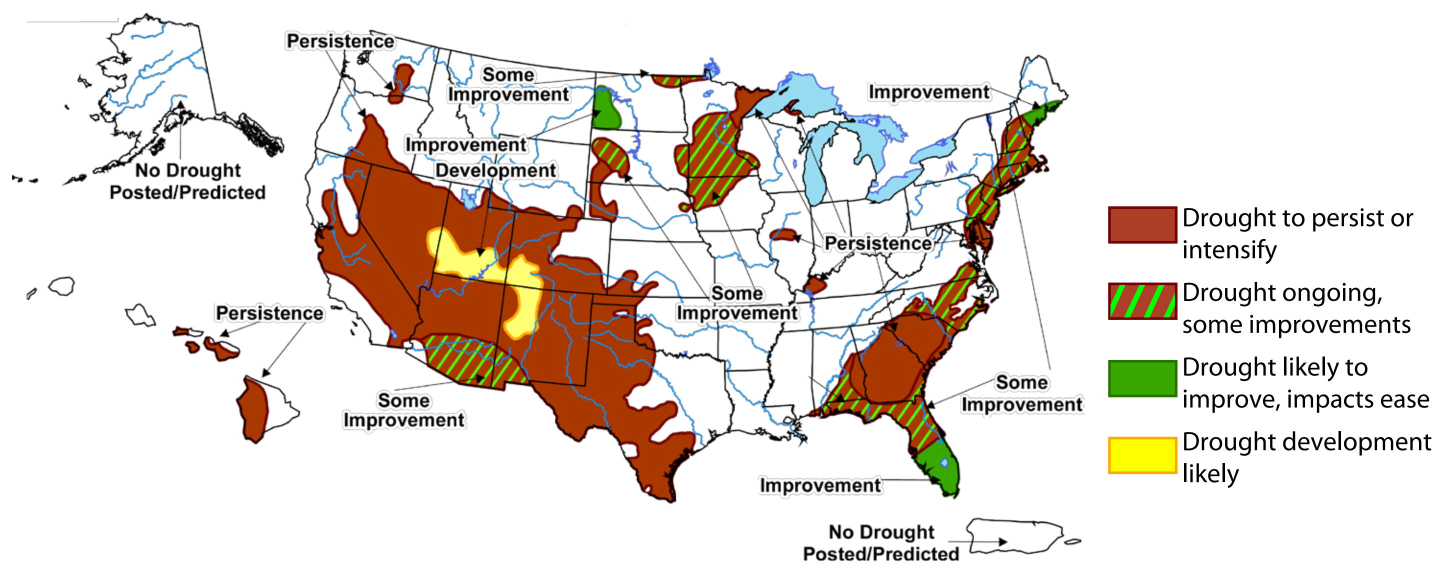
In the southwestern and western U.S., drought is expected to persist or intensify in many regions and develop in the central Rocky Mountains (*Figure 11*). This forecast is based in part on the dry conditions the Southwest and California typically experience during April through June. The period is also expected to be warmer than average, which, in conjunction with typically windy weather, can enhance dry conditions by increasing evaporation and transpiration. In addition, current mountain snowpacks—the source of much of the region's water supply—are below average at every snow monitoring site currently reporting in Arizona, New Mexico, Utah, Colorado, and Wyoming. As a result, the landscape likely will be subject to a longer dry season, and summer streamflows will very likely be below average.

The only exception to persisting or intensifying drought is in southern New Mexico and Arizona, where the onset of monsoon rains in late June and early July should provide some drought improvement. The onset date of the monsoon and total precipitation during July–September are difficult to forecast. However, on average, the monsoon begins between June 26 and July 3 in southwestern New Mexico and between July 3 and July 10 in southeastern Arizona. The CPC assigns a high confidence to this forecast.

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 July (released April 19).



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

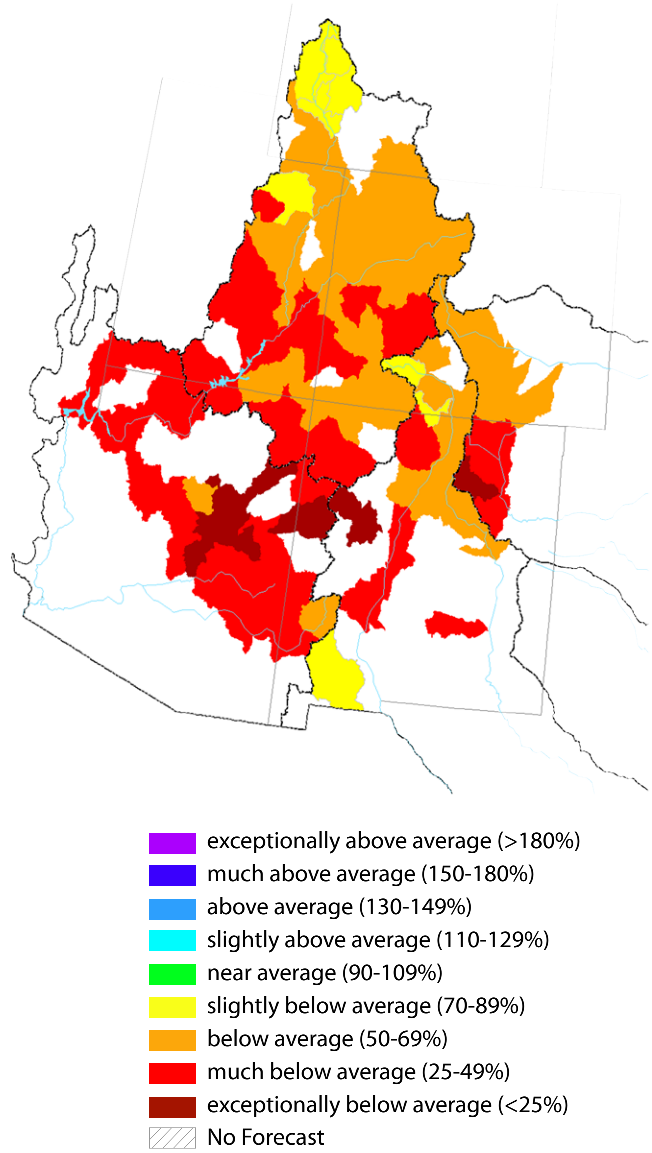
The April 1 spring-summer streamflow forecast for the Southwest shows a 50 percent chance that all basins in the Colorado River, Rio Grande, and Arkansas watersheds will be below average (*Figure 12*). In many basins, forecasts call for flows to be less than 50 percent of average, including the Upper Colorado River and Rio Grande.

In Arizona, there is a 50 percent chance that the Salt, Verde, and Gila rivers will have streamflows equal to or less than 28, 41, and 7 percent of the February–May average, respectively. These values reflect the persistence of dry conditions since January 1, which were influenced by a La Niña event that contributed to snow and rain accumulations of less than 50 percent of average in many areas.

Winter precipitation in New Mexico was slightly more frequent than in Arizona and delivered more rain and snow, but most streamflow forecasts still project below-average flows. There is a 50 percent chance that the March–July flow in the Rio Grande will be less than or equal to 44 percent of average.

All snow-monitoring stations in the Upper Colorado River Basin are reporting below-average snowpacks, with most measuring less than 50 percent of the historical average. Many stations have been persistently below average this winter. As a result, spring inflow to Lake Powell is forecast to be only about 3.5 million acre-feet, or 44 percent of the 1971–2000 April–July average. This is a substantial decrease from forecasts issued on March 1, which called for inflow to be about 5.3 MAF. Combined water storage in Lakes Mead and Powell will almost assuredly decrease this spring. However, last winter's exceptionally high streamflows, which delivered about 7 million acre-feet more than average to Lakes Mead and Powell, will help buffer below-average flows in the Colorado River this year.

Figure 12. Spring and summer streamflow forecast as of April 1 (percent of average).



Notes:

Water supply forecasts for the Southwest are coordinated between the National Water and Climate Center, part of the U.S. Department of Agriculturwwe's Natural Resources Conservation Service (NRCS), and the Colorado Basin River Forecast Center (CBRFC), part of NOAA. The forecast information provided in Figure 12 is updated monthly by the NWCC. Unless otherwise specified, all streamflow forecasts are for streamflow volumes that would occur naturally without any upstream influences, such as reservoirs and diversions. The coordinated forecasts by NRCS and NOAA are only produces for Arizona between January and May, and for New Mexico between January and May.

The NRCS provides a range of forecasts expressed in terms of percent of average streamflow for various exceedance levels. The 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. The CBRFC provides a range of streamflow forecasts in the Colorado Basin ranging from short fused flood forecasts to longer range water supply forecasts. The water supply forecasts are coordinated monthly with NWCC.

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
http://www.cbrfc.noaa.gov

Wildland Fire Outlook

(May–July 2012)

Sources: National Interagency Coordination Center, Southwest Coordination Center

Significant wildfire potential is expected to increase from normal to above normal across most of Arizona and the western third of New Mexico during the May–July period, according to the April 1 seasonal fire outlook issued by the National Interagency Coordination Center's Predictive Services (*Figure 13*). Significant wildfire potential is defined as the likelihood that a wildland fire will require additional fire-fighting resources from outside the area in which the fire originated.

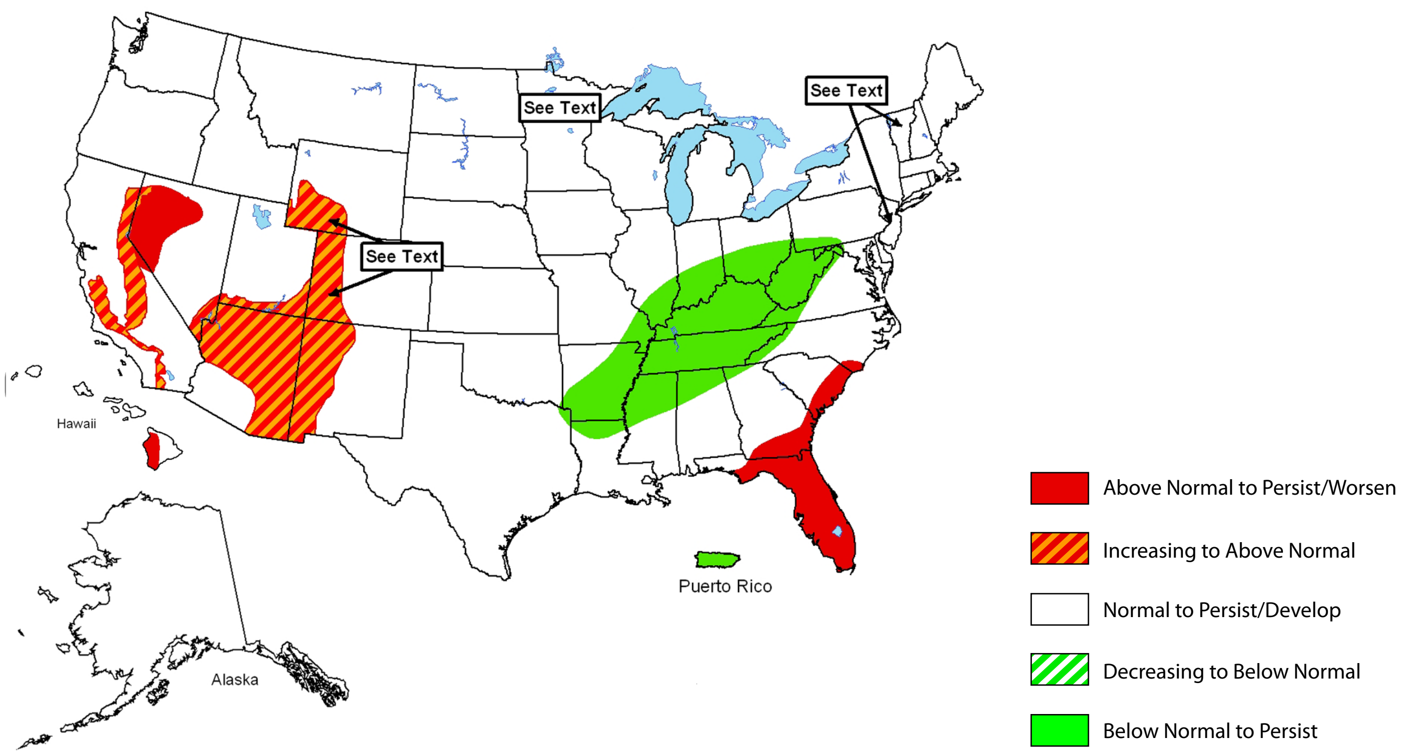
Warmer- and drier-than-average conditions that characterized the winter and spring in most of Arizona and western New Mexico influence this outlook in countervailing ways. While these conditions contributed to the persistence of drought and low soil moistures—two factors that can prime the landscape for fires—they also have stunted the growth of grasses and small woody shrubs, which is expected to delay the onset of the wildfire season. Also, because grasses and shrubs are not as vigorous as they were one year ago, there is moderate confidence that large-scale fires will not be as widespread or frequent this summer as last.

The El Niño-Southern Oscillation (ENSO), however, is a wildcard for the upcoming fire season. If El Niño conditions develop this summer—a slight possibility at present—the northwestern portions of the Southwest may experience cooler and wetter conditions than expected, while southeastern areas may see drier conditions. The ENSO forecasts will become clearer in upcoming months.

Notes:

The National Interagency Coordination Center at the National Interagency Fire Center produces seasonal wildland fire outlooks each month. The forecasts (Figure 13) consider observed climate conditions, climate and weather forecasts, vegetation health, and surface-fuels conditions in order to assess fire potential for fires greater than 100 acres. They are subjective assessments, that synthesize information provided by fire and climate experts throughout the United States.

Figure 13. National wildland fire potential for fires greater than 100 acres (valid May–July 2012).



On the Web:

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

Southwest Coordination Center web page
http://gacc.nifc.gov/swcc/predictive/outlooks/outlooks.htm

El Niño Status and Forecast

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

The La Niña conditions that have dominated since September and contributed to the dry conditions in the Southwest ceded ground to ENSO-neutral conditions in the first two weeks of April. Sea surface temperatures (SSTs) in the east-central tropical Pacific Ocean remain slightly negative at -0.3 degrees Celsius below average but are no longer cool enough to be characterized as La Niña. Several indicators point to conditions remaining ENSO-neutral over the next several months, including a large pool of warmer-than-average water just below the surface in the eastern Pacific Ocean. As this water makes its way to the surface, it will warm SSTs to near- or above-average temperatures, consistent with an ENSO-neutral state. Despite warming of the SSTs in recent weeks, the atmosphere is still reflecting La Niña-like circulation patterns and the Southern Oscillation Index (SOI) remains positive, according to the NOAA-Climate Prediction Center (NOAA-CPC; *Figure 14a*). Changes in the atmosphere typically lag behind changes in SSTs.

Overall, most models project that neutral conditions will persist through the upcoming summer months. The official forecast issued jointly by the CPC and International Research Institute for Climate and Society (IRI) indicates a high likelihood that ENSO-neutral conditions will be present during May–July and assigns greater than a 55 percent chance that neutral conditions will persist through the June–August season (*Figure 14b*). Also, several dynamical models are starting to pick up on the possibility of El Niño conditions developing as early as the July–September season. A shift towards El Niño this summer could decrease summer rains; there is a weak correlation between El Niño and below-average monsoon rain in southeastern areas of the region. Also, if El Niño continues into late 2012, the event will increase chances for above-average precipitation in the fall and winter.

Notes:

The first figure shows the standardized three month running average values of the Southern Oscillation Index (SOI) from January 1980 through March 2012. 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, 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 14a. The standardized values of the Southern Oscillation Index from January 1980–March 2012. 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).

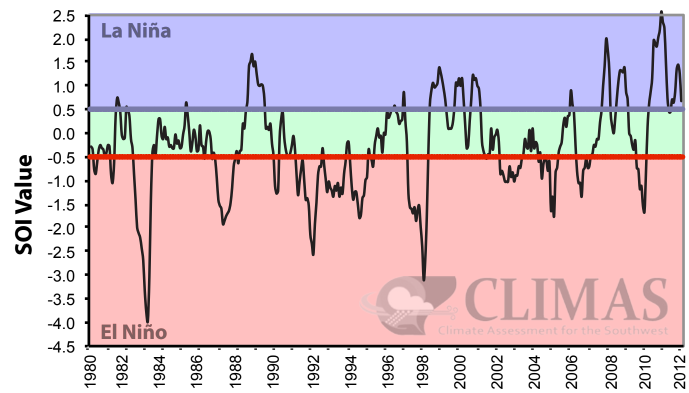


Figure 14b. IRI probabilistic ENSO forecast for El Niño 3.4 monitoring region (released April 19). Colored lines represent average historical probability of El Niño, La Niña, and neutral conditions.