March 24, 2011

Southwest Climate Outlook

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Source: Rebecca L. Macaulay, Santa Rita Prickly Pear, *Oil on Canvas, 24"x48," Collection of Mr. Ted A. Schmidt.*

Photo Description: Despite drier-than-average conditions in many regions of the Southwest, Prickly Pear cacti and other flowers should color the southwestern deserts this spring.

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...

CLIMAS Climate Assessment for the Southwest

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NM STATE UNIVERSITY

March Climate Summary

Drought– The continuation of unusually dry weather across southern Arizona and New Mexico has caused drought conditions to expand and intensify over the past 30 days. Much of southeast Arizona and southern New Mexico are now classified under severe to extreme drought status.

Temperature– Temperatures this last month have been much warmer than average in New Mexico and near average or slightly cooler than average in Arizona.

Precipitation– La Niña is living up to its reputation with extremely dry conditions across most of New Mexico and southern Arizona.

ENSO– La Niña continues to weaken but will continue to impact weather across the western U.S. through spring. There is growing evidence that ENSO-neutral conditions will return to the Pacific Ocean by summer.

Climate Forecasts– Seasonal temperature and precipitation outlooks, influenced by this winter's La Niña event and recent warming trends, call for warmer-than-average temperatures across the Southwest through the spring and summer and drier-than-average conditions through spring.

The Bottom Line– Once again this month, conditions across much of the Southwest have been dominated by the ongoing La Niña event. Though there is evidence that the La Niña is weakening, most of southern Arizona and New Mexico are likely to continue feeling the impacts of the dry winter. While the northwestern part of Arizona has seen some reprieve from recent drought conditions, the low precipitation and subsequently dry soils across much of the southern portions of both states will continue to have an impact. Unfortunately the forecasts do not offer much optimism, with the outlook for the remainder of the spring being warm and dry for most of the region.

New Report on Food Security in the Southwest Borderlands

Declining water supplies, protracted drought, and decreasing wealth in the borderlands of Arizona and New Mexico are placing unprecedented pressures on food production in the region, threatening future production but also sparking innovative adaptation strategies, according to a new report by Sabores Sin Fronteras, or Flavors Without Borders.

The report was generated from workshops convening farmers, ranchers, food bank professionals, gardeners, scholars, and others, and is the first regional assessment of food security for the Southwest. According to the report, the rates of hunger and poor nutrition in Arizona and New Mexico are rising and outpacing the national average. Arizona is currently the second poorest state and New Mexico is ranked third; rankings are based on family income. Also, prime farmland in Arizona and New Mexico declined by 35 and 33 percent, respectively, between 1982 and 2007.

Despite these challenges, borderlands residents are innovating and redesigning their foodsheds. For example, farmers markets are on the rise in the region. Arizona and New Mexico have 135 farmers' markets, which have produced more than $1 million in gross sales since 2001. The report also offers preliminary recommendations for other measures that can make food systems healthier and more resilient to future change.

You can read the report on the Sabores Sin Fronters website at www.saboresfronteras.com.

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

Rising temperatures bump up risk of wildfires

By Melanie Lenart and Zack Guido

Note: CLIMAS Associate Staff Scientist Zack Guido adapted and updated this article from a version by Melanie Lenart that was published in the Southwest Climate Outlook in 2006. The scientific results and statements from local experts remain unchanged.

A bolt of lightning singed the dry earth in 2005, sounding the death knell of the Grand One. The resulting Cave Creek Fire raced through knee-high grasses and shrubs, burning nearly 250,000 acres in the Arizona Sonoran Desert, including the site where the Grand One had stood for an estimated 150 to 200 years. The world's largest recorded saguaro, standing 45 feet tall and nearly 7 feet wide, could not withstand the flames, finally collapsing to the desert floor in 2007.

Other recent blazes have consumed large swaths of forests, deserts, and grasslands in the Southwest. In 2000, a fire burned 47,000 acres around Los Alamos, New Mexico, destroying about 260 homes and requiring the evacuation of about 20,000 people. Arizona's largest fire on record, the 468,000 acre Rodeo-Chediski Fire in the northern part of the state, destroyed about 400 homes and forced the evacuation of 30,000 people in 2002.

Figure 1. The world's largest recorded saguaro cactus burned during the 2005 Cave Creek Fire outside of Phoenix and later died. Image source: Stephanie Doster, Institute of the Environment.

With dry conditions prevailing in many regions in the Southwest this winter, wildland fire fighters are gearing up for a potentially active season. This may be a harbinger of the future, as the number of wildfires is expected to increase as a result of warming temperatures.

The fuel factor

In the forest, it takes about 40 hot, dry days (roughly 1,000 hours) to convert fallen branches on the forest floor into flammable material that will magnify a fire's heat—perhaps enough to ignite live saplings. These saplings, in turn, can become ladders to lift the flames into the crowns of established trees. Branches and logs from three to six inches in diameter are the "1,000-hour fuels" that firefighters worry about when gauging forest fire danger and evaluating whether a surface fire might spring into a crown fire.

Seasonally, fire danger fluctuates with the moisture condition of grasses and downed wood, respectively known as fine and heavy fuels in firefighter parlance. At longer time scales, explosive growth of saplings makes southwestern forests more prone to large-scale crown fires.

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Rising temperatures, continued

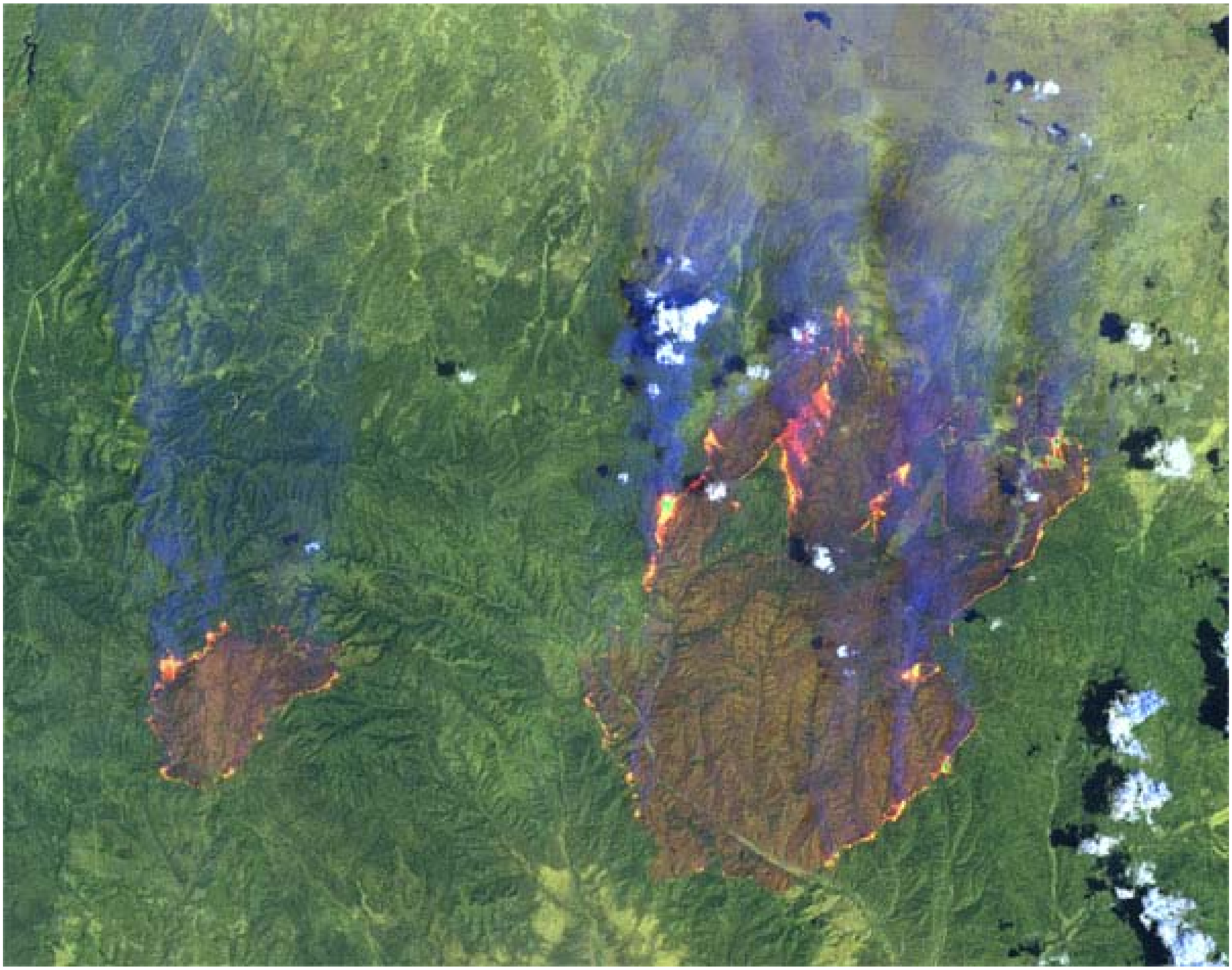

Figure 2. The Rodeo-Chediski Fire was the largest wildland fire on record in Arizona. It burned 468,000 acres in northern Arizona, destroyed about 400 homes, and forced 30,000 people to evacuate in 2002. This image is from June 21, 2002. Image credit: Jesse Allen, NASA.

The bark beetles and drought that killed millions of pines in recent years appear to have contributed to reducing fire risk—at least temporarily—by reducing the amount of flammable foliage in the forest.

"If you don't have a canopy—all you have is dead sticks sitting up there—you probably decrease the risk of catastrophic crown fires," said Neil Cobb, professor in the department of biological sciences at Northern Arizona University. However, once the beetle-killed trees start falling to the ground, their wood will join the 1,000-hour fuels that potentially can ignite future conflagrations.

Climate variability and change also influences fuel build-up to an extent that makes it difficult for people to reduce fire danger on the regional scale without allowing a return to the natural fire regime. Global warming is likely to increase climate variability, with larger swings from wet to dry and back again. Some project global warming will increase the magnitude of events associated with El Niño and La Niña.

Records compiled from historic observations, tree rings, and charcoal deposits all indicate large climate swings boost the potential for severe fires in highland forests. Wet periods encourage abundant growth in forests—many small trees pop up to celebrate the moisture. This increases the risk of stand-level drought during dry periods that follow, with a multitude of tree stems drawing from the same pool, like too many straws in a drink.

When it's hot

Temperature has an established link with fire danger on several fronts. Fires light more readily when the sun is beating down and raising daily temperatures. Lightning bolts fly more often with

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Rising temperatures, continued

higher temperatures, too, providing more opportunities for fire ignitions. And fires can spin out of control more easily when overlying air is warm, especially in the absence of cool nights that help the fire to "lay down."

In 2006, researchers reported that the number of large western wildfires tends to move up and down with spring and summer temperatures, based on U.S. Forest Service and National Park Services data from 1970 to 2003. The ground-breaking paper published by Anthony Westerling and colleagues, including the UA's Thomas Swetnam, linked the earlier snowmelt during warmer-than-average springs and summers to an increase in large, western wildfires, especially since the mid-1980s.

In another analysis, published in 2004, which included 11 western states, New Mexico and Arizona were among the most sensitive to temperature effects on the annual "area-burned"—the amount of land crossed by fire in a given year. U.S. Forest Service researcher Donald McKenzie and colleagues found higher temperatures led to a "sharp increase" in area-burned in the historical record, using data spanning 1916 through 2002. New Mexico's annual area-burned fluctuates with spring temperatures in particular, the analysis by McKenzie and colleagues showed.

Similarly, research by the University of Arizona's Michael Crimmins and Andrew Comrie in 2004 found low-elevation fires in southern Arizona increased during warm springs when they followed wet winters.

Warm air also can generate winds that fan a blaze, potentially turning a small fire into a firestorm.

"If you have warmer surface temperatures, the atmosphere is more unstable. That's more conducive to strong convection and to blow-up fires" like the Rodeo-Chediski, said Charles Maxwell, fire weather program manager for the Southwest Coordination Center.

A warm surface, whether caused by a fire or a mountainside baking in the hot summer sun, will lift air parcels up into the atmosphere. A fire tends heat and lift air parcels faster, which adds to the instability. The ascent of these air parcels leaves a void that surrounding air quickly moves to fill. These winds further fan the flames.

Warmer air also tends to increase the incidence of lightning, which causes about 80 percent of the fire starts in the West. However, lightning strikes remain relatively unpredictable despite their importance in igniting western wildfires.

Looking to the future, observed links between warm temperatures and fires spark concern for the impacts of global warming.

Woody materials are likely to remain dry longer as the climate warms, Timothy Brown of the Desert Research Institute in Nevada and colleagues projected, based on the expected impact of warmer temperatures and their influence on relative humidity. Their modeling experiment focused on forests, comparing conditions for two decades through 1996 to those projected for two decades through 2089 using a global warming scenario.

"The key thing was an increase in the number of days of high fire danger," Brown said. "We basically found throughout the West that the number of days increased by about two to three weeks."

When it's humid

Air temperature also wields an important effect on relative humidity.

Hot air can hold more moisture than cool air, which is partly why higher daytime temperatures are linked to higher evaporation rates. Conversely, when air cools during the night, its relative humidity increases, sometimes to the point of saturation. If the air drops down to the dewpoint temperature, some of the moisture it contains will condense into dew, fog, or some other form of precipitation.

Whether moisture condenses or not, higher relative humidity levels reduce fire danger.

"In the evening, temperatures will go down and the humidity levels will start to increase again. We call it a recovery. If we have not much of a recovery at all at night, we can have active burning during the night and this can also make it worse the next day," said Gary Daniel, Tonto National Forest fire manager.

Both global warming and the urban heat island effect tend to boost nighttime temperatures more than daytime temperatures. That's because greenhouse gases and concrete absorb solar radiation. After a long day of solar heating, they release some of the energy they've collected as infrared radiation—in other words, heat. This is most noticeable at night, once the sun's direct rays are out of the picture.

Recent temperature trends in the Southwest amount to warming of a few degrees Fahrenheit in the last 100 years. For many, this small change is imperceptible. To the landscape, it is tactile. More and larger fires have been charring the region than in the past, some with devastating effects like the Cave Creek and Rodeo-Chediski fires.

Whether or not this year contributes to increasing trends is anyone's guess. But conditions look ripe for an active fire season. Both temperature and precipitation forecasts for the next several months show increased chances for above-average temperatures and below-average rainfall. If these expectations unfold, more saguaros, like the Grand One, could find themselves in the path of fire.

Temperature (through 3/16/11)

Data Source: High Plains Regional Climate Center

Temperatures in the new water year (since October 1) continue to average between 55 and 65 degrees Fahrenheit in the southwest deserts and along the lower Colorado River, 45 to 55 in southeastern Arizona, 40 to 50 in southern New Mexico, and 30 to 45 across the Colorado Plateau and central and northern New Mexico (Figure 1a). These temperatures generally have been 0–2 degrees warmer than average across most of Arizona, with a few isolated locations that have been 0–2 degrees cooler than average (Figure 1b). Gila County, AZ, and Taos County, NM, and along the border of Luna and Grant counties, NM, temperatures have been 2–4 degrees warmer than average. This is similar to the early winter which was warmer than average. Mid-December through mid-February was colder than average across most of the Southwest. Temperatures over the past 30 days were 0–4 degrees warmer than average across the eastern two-thirds of Arizona and the western half of New Mexico. Eastern New Mexico was 2–6 degrees above average with Otero, Eddy, and southern Chavez counties 6 –10 degrees warmer than average. Only the western third of Arizona had temperatures slightly cooler than average (Figures 1c–d). The temperature gradient shows the storm paths this winter, with more frequent storms across western Arizona and very few storms across southeastern New Mexico. Fortunately, the storms have generally been quite cold at the highest elevations, dropping snow rather than rain.

Figure 1a. Water year '10–'11 (October 1 through March 16) average temperature.

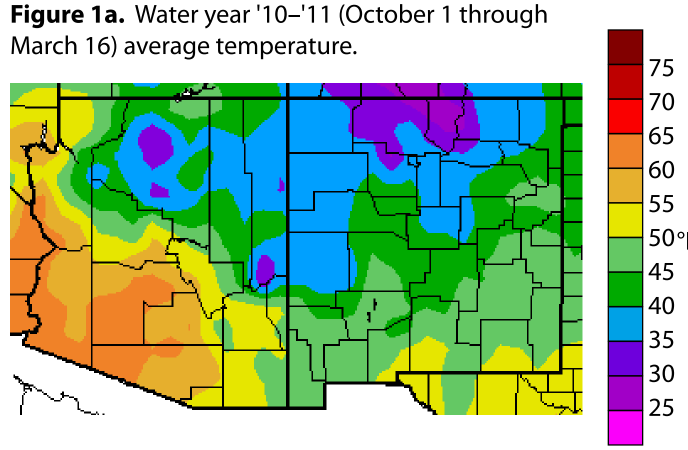


Figure 1b. Water year '10–'11 (October 1 through March 16) departure from average temperature.

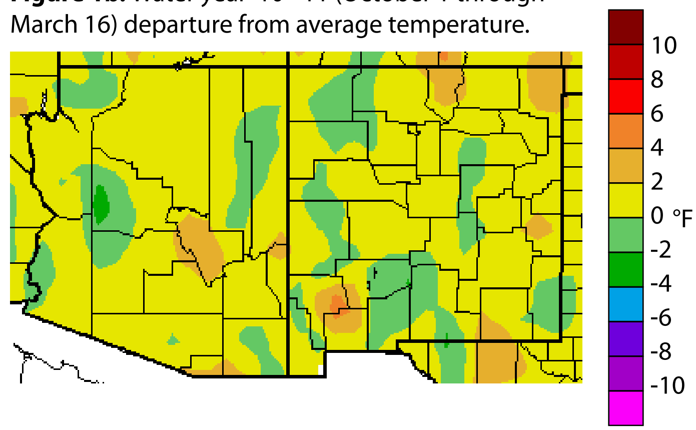


Figure 1c. Previous 30 days (February 15–March 16) departure from average temperature (interpolated).

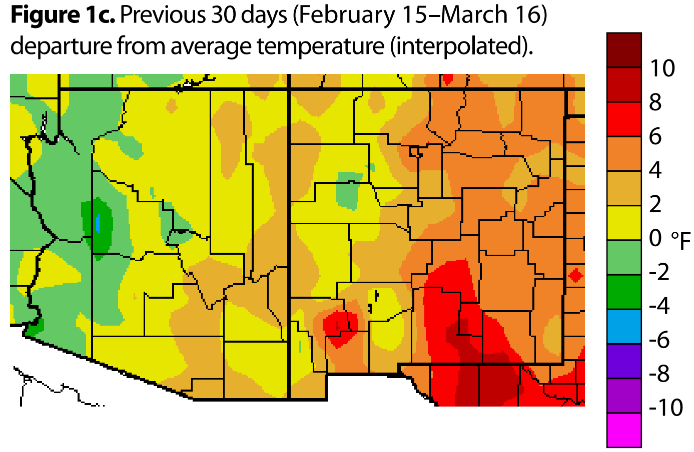
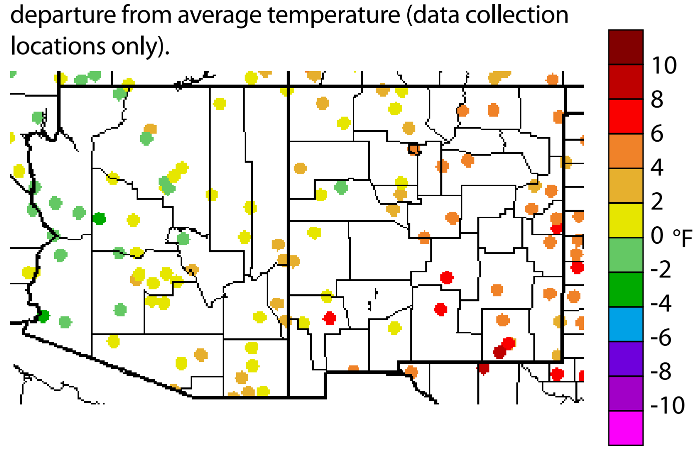


Figure 1d. Previous 30 days (February 15–March 16) departure from average temperature (data collection locations only).



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

Precipitation (through 3/16/11)

Data Source: High Plains Regional Climate Center

The few storms during the 2011 water year (from October 1) generally have moved from southwest to northeast across the southwestern U.S. Virtually all of the winter storms have passed over the northwest corner of Arizona, while very few storms have moved through southern New Mexico or southeastern Arizona. This has left a precipitation gradient, with dry areas in the southeast receiving less than 50 percent of average precipitation and relatively wet areas to the northwest receiving 130 percent to more than 300 percent of average precipitation (Figures 2a–b). Most areas in between have received less than 70 percent of average. Southeastern San Juan County in northwestern New Mexico also received more than 300 percent of average precipitation. The pattern of the past 30 days has been very similar, with 150–300 percent of average precipitation along the lower Colorado River and the northwest corner of New Mexico, less than 5 percent of average across all of New Mexico except the northernmost counties, and 5– 50 percent of average precipitation in southeastern Arizona (Figures 2c–d). This is a typical pattern for a La Niña year, during which storms tend to remain well north of Arizona and New Mexico. The few storms that have come through the northwest corner of Arizona have tapped into subtropical moisture, resulting in very heavy rain or snow.

Notes:

The water year begins on October 1 and ends on September 30 of the following year. As of October 1, 2010, we are in the 2011 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 '10–'11 (October 1 through March 16) percent of average precipitation (interpolated).

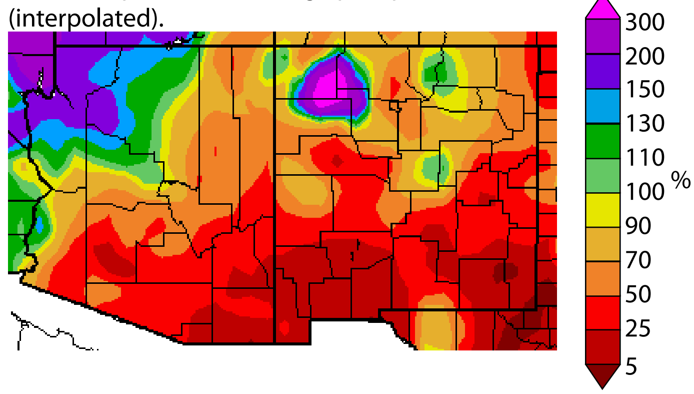


Figure 2b. Water year '10–'11 (October 1 through March 16) percent of average precipitation (data collection locations only).

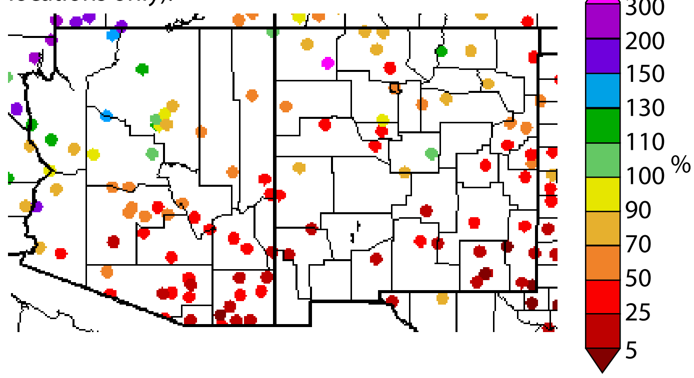


Figure 2c. Previous 30 days (February 15–March 16) percent of average precipitation (interpolated).

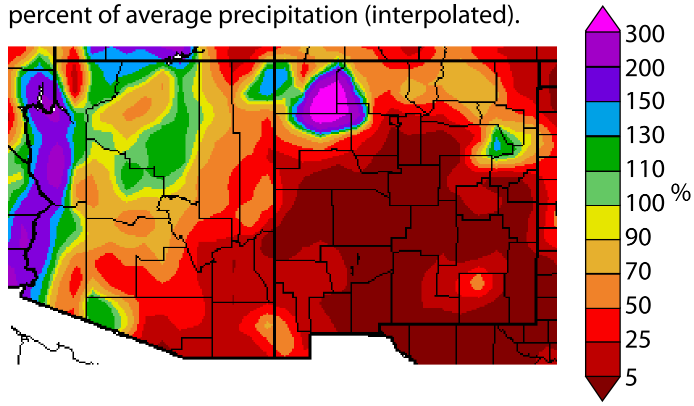
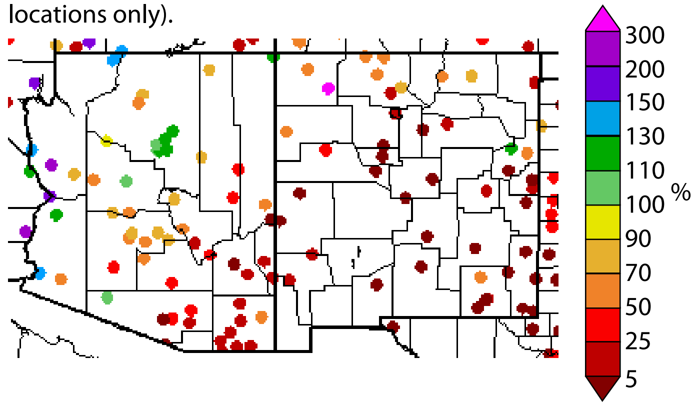


Figure 2d. Previous 30 days (February 15–March 16) percent of average precipitation (data collection locations only).



U.S. Drought Monitor

(data through 3/15/11)

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

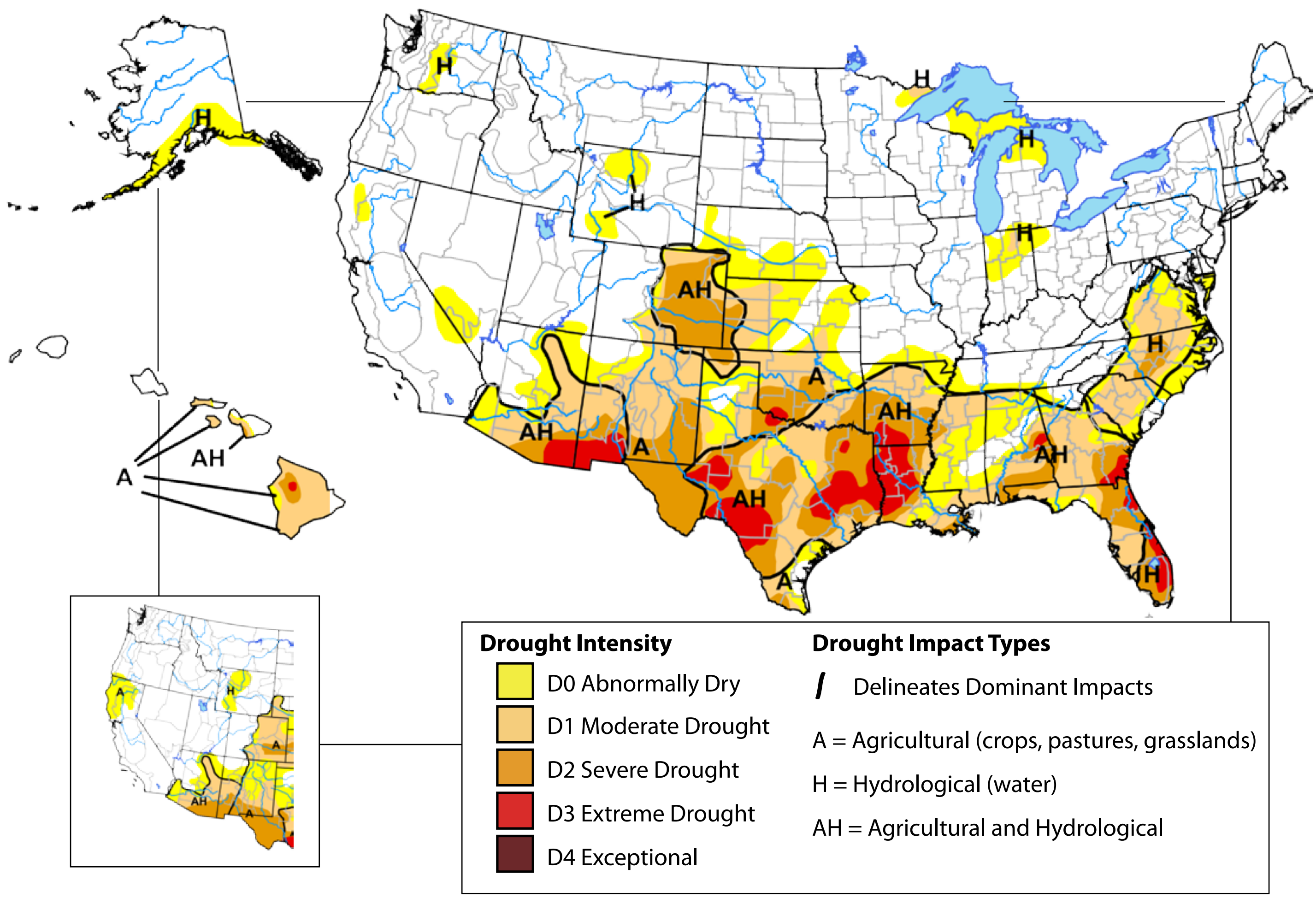
Drought conditions across the western U.S. have changed little over the past 30 days due to an active weather pattern that has brought average to above-average precipitation to most areas except Arizona, New Mexico, and eastern Colorado (Figure 3). Much of the Southwest has missed out on winter storm activity and precipitation that has fallen over the past 30 days, causing drought conditions to expand and intensify. Severe drought has expanded to cover almost all of eastern Colorado while moderate drought conditions have expanded across portions of New Mexico and Arizona. Extreme drought has also crept into extreme southeastern Arizona and southwestern New Mexico over the past 30 days. These areas have observed less than a quarter of their normal winter season precipitation with little chance of making up any ground over the upcoming normally hot and dry spring season.

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 Laura Edwards, Western Regional Climate Center.

Figure 3. Drought Monitor data through March 15 (full size), and February 15 (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

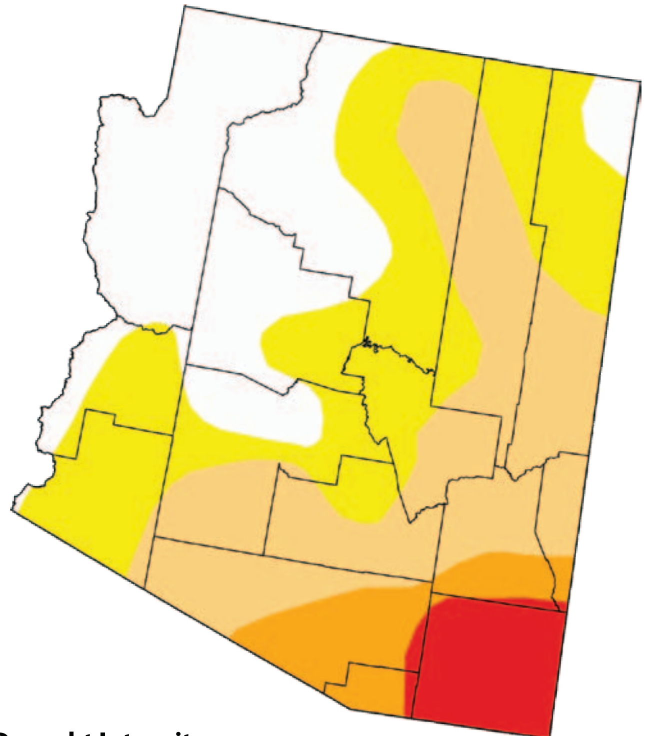
(data through 3/15/11)

Data Source: U.S. Drought Monitor

Precipitation was hard to come by across southern Arizona over the past 30 days, causing short-term drought conditions to continue to worsen, according to the March 15 update of the U.S. Drought Monitor (Figures 4a–b). Moderate to severe drought conditions continue to cover much of southern and eastern Arizona, where less than 50 percent of average precipitation has fallen over the past three months. Extreme drought conditions have crept into far southeast Arizona, where observed winter season precipitation has been less than 25 percent of average. Drought impact reports submitted through AZ DroughtWatch (http://azdroughtwatch.org) describing poor range conditions, little or no water in seasonal streams, and poor condition or mortality in native plant species are consistent with the severe to extreme drought status across southern Arizona.

Northwestern Arizona, on the other hand, remains drought free due to above-average precipitation delivered to the region over the past several months. Reports of deep snowpacks, plentiful soil moisture, and the green-up of some low desert areas are all positive signs of a turn-around in short-term drought conditions that plagued this area just last summer.

Figure 4a. Arizona drought map based on data through March 15.



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 15.

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	28.64	71.36	40.88	12.59	5.96	0.00
Last Week (03/08/2011 map)	29.07	70.93	40.88	12.59	5.60	0.00
3 Months Ago (12/14/2010 map)	5.65	94.35	26.15	0.00	0.00	0.00
Start of Calendar Year (12/28/2010 map)	31.40	68.60	32.45	0.00	0.00	0.00
Start of Water Year (09/28/2010 map)	40.00	60.00	18.58	3.23	0.00	0.00
One Year Ago (03/09/2010 map)	23.75	76.25	30.29	9.17	0.00	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 3/15/11)

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

Very little precipitation fell across New Mexico over the past 30 days, causing drought conditions to continue to expand and intensify. According to the March 15 update of the U.S. Drought Monitor over 92 percent of the state is observing some level of drought, with more than 84 percent of the area classified as moderate drought or worse (Figure 5a–b). The biggest changes in drought conditions since last month were the expansion of moderate drought from the southern half of the state up through the entire northeast quarter. Severe drought also expanded across the southeast quarter of the state. Extreme drought was introduced across the southwest counties of Hidalgo, Grant, and Luna, where less than 25 percent of average precipitation has fallen over the past 90 days. La Niña and its impact on the winter storm track is the most likely culprit behind the winter dry spell and worsening drought conditions across the Southwest. Dry conditions are expected to persist through the upcoming spring season, especially across southern New Mexico, which will most likely cause drought conditions to expand and intensify.

Figure 5a. New Mexico drought map based on data through March 15.

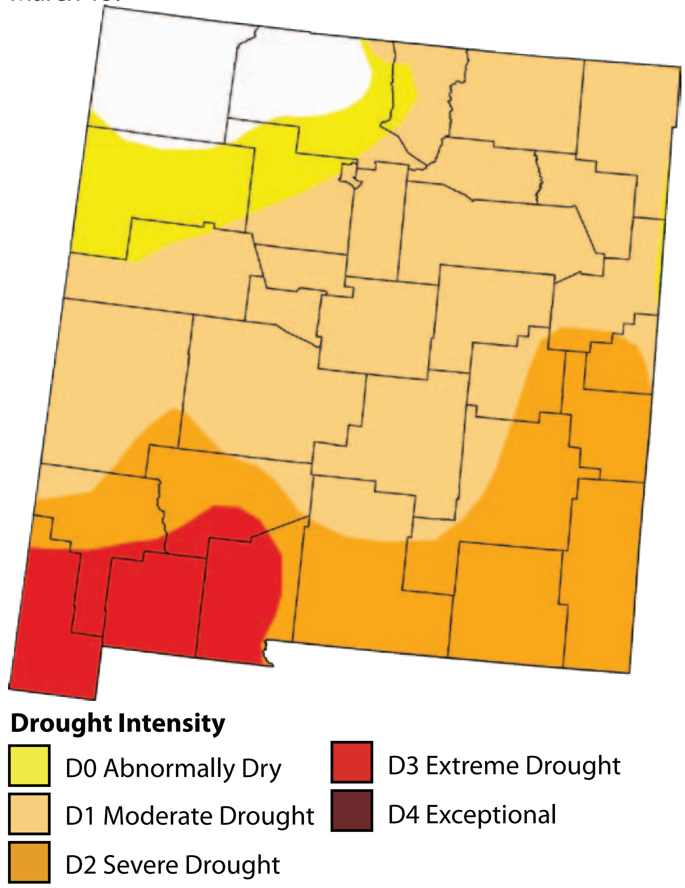


Figure 5b. Percent of New Mexico designated with drought conditions based on data through March 15.

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	7.79	92.21	84.02	33.82	9.25	0.00
Last Week (03/08/2011 map)	7.97	92.03	62.56	33.32	0.17	0.00
3 Months Ago (12/14/2010 map)	5.18	94.82	15.99	0.00	0.00	0.00
Start of Calendar Year (12/28/2010 map)	6.16	93.84	40.40	0.00	0.00	0.00
Start of Water Year (09/28/2010 map)	76.66	23.34	0.00	0.00	0.00	0.00
One Year Ago (03/09/2010 map)	76.26	23.74	0.00	0.00	0.00	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 2/28/11)

Data Source: USDA-NRCS, National Water and Climate Ctr.

Combined storage in Lakes Mead and Powell decreased by 242,000 acre-feet in February. While Lake Mead increased by 352,000 acre-feet, Lake Powell decreased by 594,000 acre-feet. As of March 1, combined storage was at 48.2 percent of capacity, which is 2.4 percent less than a year ago, or about 1.2 million acre-feet (Figure 6). Storage in the Salt and Verde river basins and the San Carlos Reservoir increased slightly, by about 8,500 acre-feet. Total reservoir storage in Arizona is lower than it was one year ago and is down by 84,000 acre-feet from last month.

In water-related news, after years of drought and below-average snowpack in the upper basin of the Colorado River, primarily in Utah, Colorado, and Wyoming, this year's snowpack is about 120 percent of average, (*Arizona Daily Star*, February 27). The copious snow may delay shortages of Colorado River water for Arizona water users for several years.

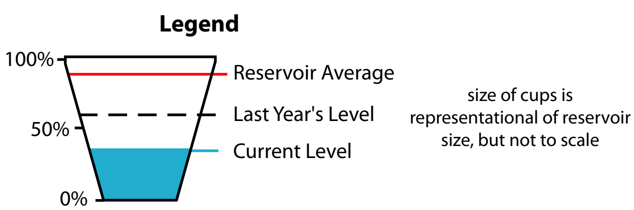
Notes:

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.

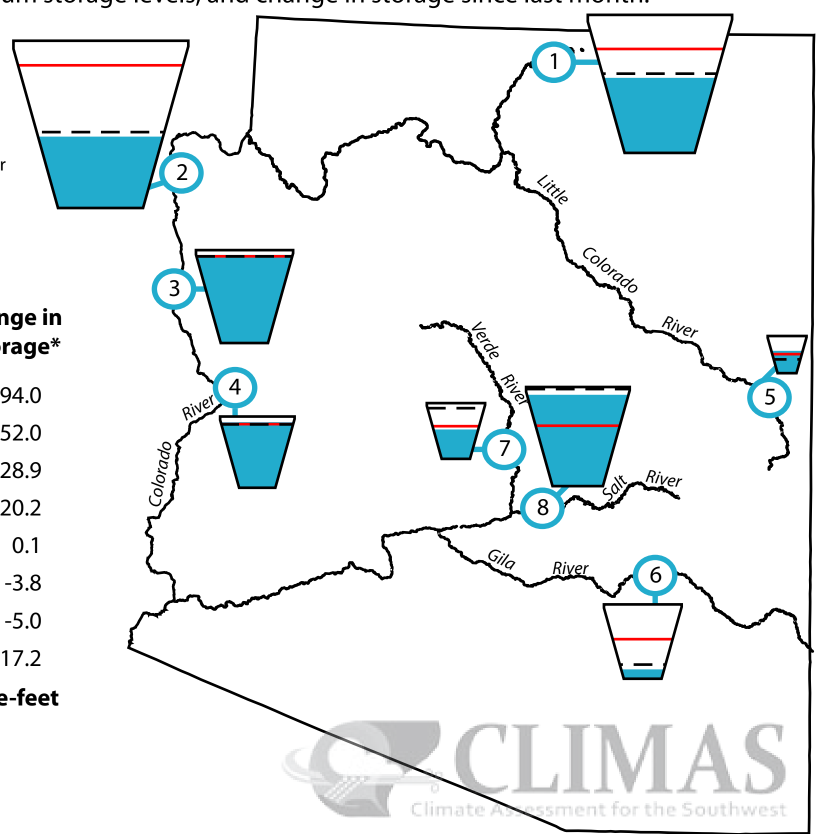
These data are based on reservoir reports updated monthly by the National Water and Climate Center of the U.S. Department of Agriculture's Natural Resource Conservation Service (NRCS). For additional information, contact Dino DeSimone, Dino.DeSimone@az.usda.gov.

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	54%	13,235.0	24,322.0	-594.0
2. Lake Mead	42%	11,117.0	26,159.0	352.0
3. Lake Mohave	94%	1,699.0	1,810.0	28.9
4. Lake Havasu	92%	566.6	619.0	120.2
5. Lyman Reservoir	60%	18.0	30.0	0.1
6. San Carlos	13%	113.6	875.0	-3.8
7. Verde River System	53%	153.1	287.4	-5.0
8. Salt River System	92%	1,869.1	2,025.8	17.2

*** 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 2/28/11)

Data Source: USDA-NRCS, National Water and Climate Ctr.

The total reservoir storage in New Mexico did not change substantially during February (Figure 7). Storage in Elephant Butte Reservoir increased by 30,600 acre-feet in the last month but is down from this time last year by about 62,000 acre-feet. Storage in the Navajo Reservoir decreased by 14,800 acre-feet but is up by about 113,000 acre feet compared with a year ago, or about 7 percent. Storage in the Pecos and Canadian river basin reservoirs increased slightly in January.

In water-related news, water managers for the middle Rio Grande expect to deliver enough water to meet the water needs of farmers from Cochiti to Socorro (*Albuquerque Journal*, March 2). To the south, water officials are less optimistic. The Elephant Butte Irrigation District stated last month that drought conditions and new rules for distributing water on the lower Rio Grande mean that customers may only receive half of their normal allotment this year.

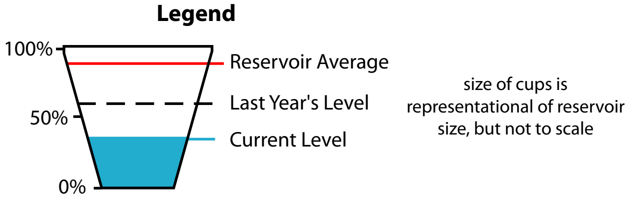
Notes:

The map gives a representation of current storage levels for reservoirs in New Mexico. Reservoir locations are numbered within the blue circles on the map, corresponding to the reservoirs listed in the table. The cup next to each reservoir shows the current storage level (blue fill) as a percent of total capacity. Note that while the size of each cup varies with the size of the reservoir, these are representational and not to scale. Each cup also represents last year's storage level (dotted line) and the 1971–2000 reservoir average (red line).

The table details more exactly the current capacity level (listed as a percent of maximum storage). Current and maximum storage levels are given in thousands of acre-feet for each reservoir. One acre-foot is the volume of water sufficient to cover an acre of land to a depth of 1 foot (approximately 325,851 gallons). On average, 1 acre-foot of water is enough to meet the demands of 4 people for a year. The last column of the table list an increase or decrease in storage since last month. A line indicates no change.

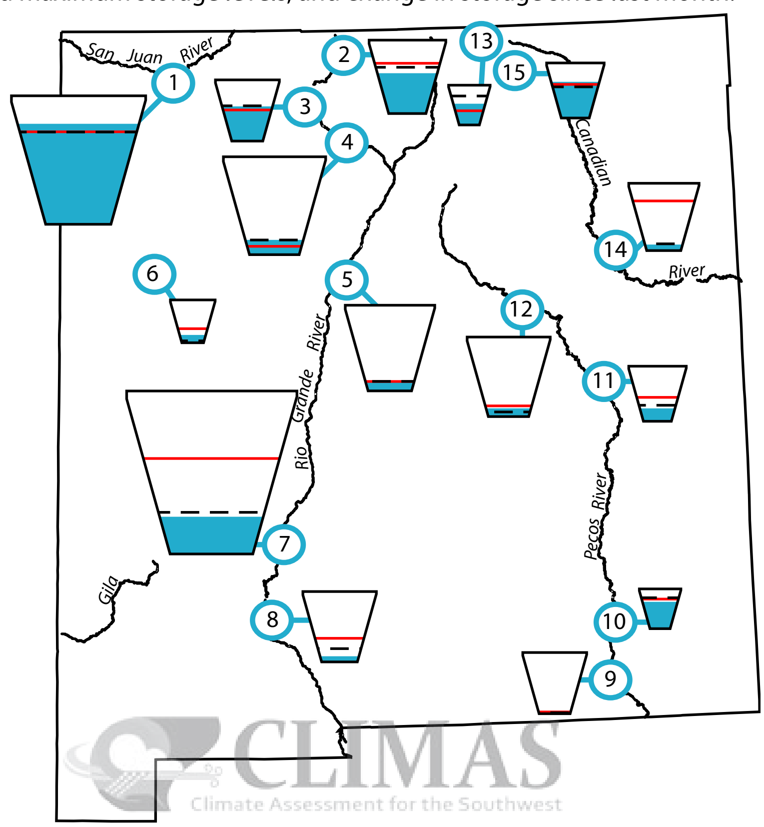
These data are based on reservoir reports updated monthly by the National Water and Climate Center of the U.S. Department of Agriculture's Natural Resource Conservation Service (NRCS). For additional information, contact Wayne Sleep, wayne.sleep@nm.usda.gov.

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.



Reservoir Name	Capacity Level	Current Storage*	Max Storage*	Change in Storage*
1. Navajo	78%	1,327.7	1,696.0	-14.8
2. Heron	55%	221.9	400.0	-1.1
3. El Vado	57%	109.0	190.3	1.3
4. Abiquiu	15%	179.2	1,192.8	-2.9
5. Cochiti	11%	52.5	491.0	-0.3
6. Bluewater	18%	6.8	38.5	0.7
7. Elephant Butte	23%	504.8	2,195.0	30.6
8. Caballo	8%	24.9	332.0	1.3
9. Brantley	1%	14.7	1,008.2	1.4
10. Lake Avalon	68%	2.7	4.0	0.4
11. Sumner	24%	24.2	102.0	0.5
12. Santa Rosa	10%	42.6	438.3	0.0
13. Costilla	53%	8.4	16.0	0.3
14. Conchas	9%	22.3	254.2	0.4
15. Eagle Nest	66%	52.0	79.0	0.5

*** 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

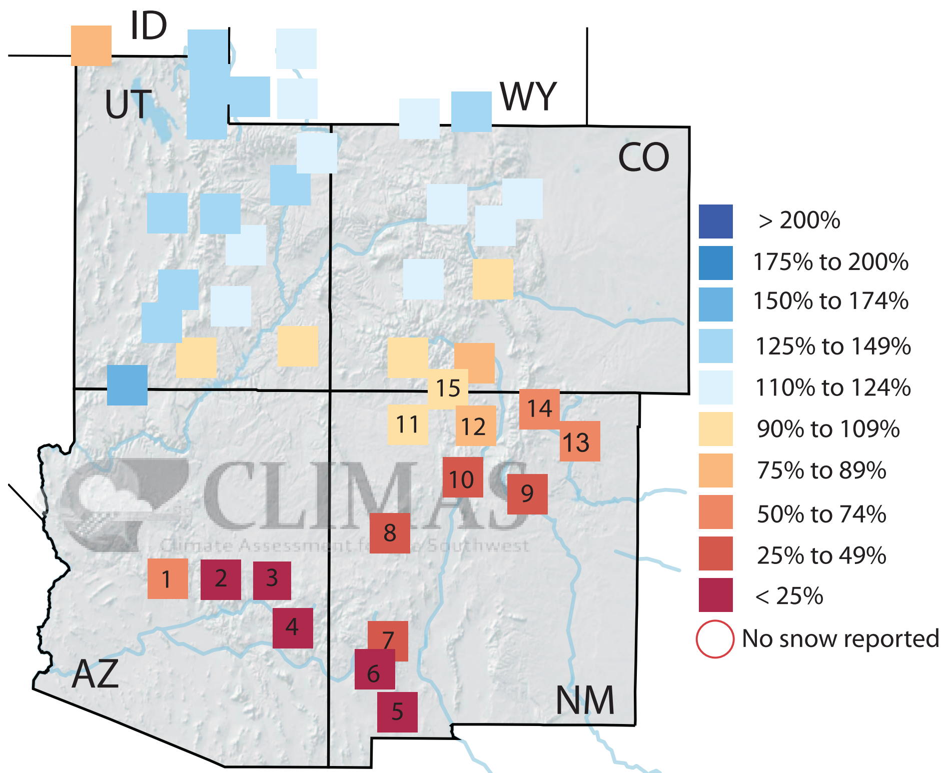
(updated 3/17/11)

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

Snowpack levels continued to drop over the past month as very little precipitation fell across most of Arizona and New Mexico. The current La Niña event drew winter storms northward into the Upper Colorado River Basin states of Utah, Colorado, and Wyoming. As of March 17, nearly all Snow Telemetry (SNOTEL) stations in Arizona and New Mexico measured below-average to well below-average snow water equivalent (SWE) (Figure 8). SWE in the central Mogollon Rim area was the lowest in Arizona, measuring only 15 percent of average. The Verde River Basin measured the highest SWE in the state, with only 53 percent of average. In New Mexico, the San Miguel, Dolores, Animas, and San Juan river basins in the northern part of the state had near-average levels measuring 92 percent of average SWE. The snowpack in the southern portion of the state fared worse, with the Mimbres, San Francisco, and Gila river basins containing only 8, 23, and 28 percent of average SWE, respectively. While many river basins in the region measured near-record levels of snowpack during the winter months of 2010, this winter was almost completely opposite.

Forecasts show a weakening La Niña pattern but still call for elevated chances of below-average precipitation for the spring months. As a result, streamflow forecasts anticipate below-average to well below-average runoff from most basins in the Southwest, except those with headwaters in the Rocky Mountains to the north of Arizona and New Mexico where precipitation has been higher this winter.

Figure 8. Average snow water equivalent (SWE) in percent of average for available monitoring sites as of March 10.



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

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

Notes:

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

This figure shows the SWC for selected river basins, based on SNOTEL sites in or near the basins, compared to the 1971–2000 average values. The number of SNOTEL sites varies by basin. Basins with more than one site are represented as an average of the sites. Individual sites do not always report data due to lack of snow or instrument error. CLIMAS generates this figure using daily SWC measurements made by the Natural Resource 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 2011–September 2011)

Data Source: NOAA-Climate Prediction Center (CPC)

The seasonal temperature outlooks issued by the NOAA–Climate Prediction Center (CPC) in March call for increased chances for temperatures to be similar to the warmest 10 years of the 1971–2000 period through the spring and summer. For the April–June period, CPC outlooks call for greater than a 40 percent chance that temperatures will resemble the warmest years in the climatological record in most of Arizona and New Mexico, and greater than a 50 percent chance in southern portions of the two states (Figure 9a). As we move into summer, temperatures in nearly all of Arizona and the western and southern portions of New Mexico have greater than a 50 percent probability of being similar to the warmest 10 years in the climatological record (Figures 9b–d). The temperature outlooks for May through August (Figures 9b-c) reflect some lingering La Niña impacts mostly resulting from very low soil moisture throughout much of the southern U.S.

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 2011.

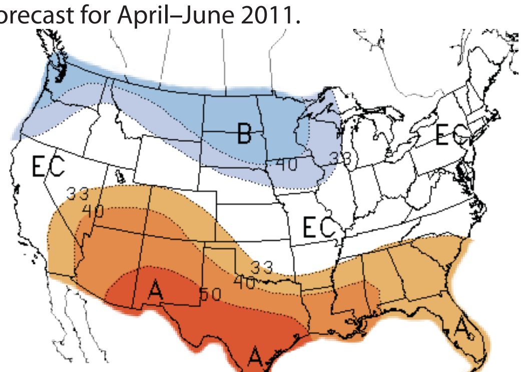
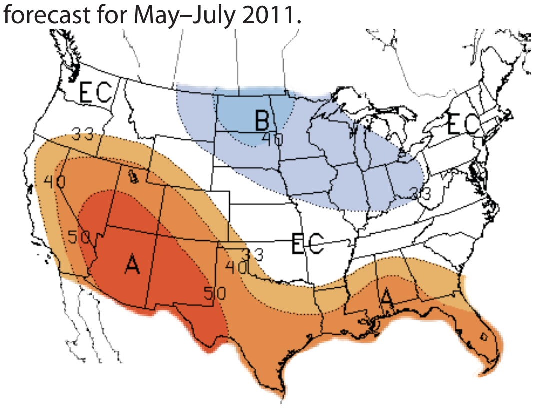


Figure 9b. Long-lead national temperature forecast for May–July 2011.



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

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

EC = Equal chances. No forecasted anomalies.

Figure 9c. Long-lead national temperature forecast for June–August 2011.

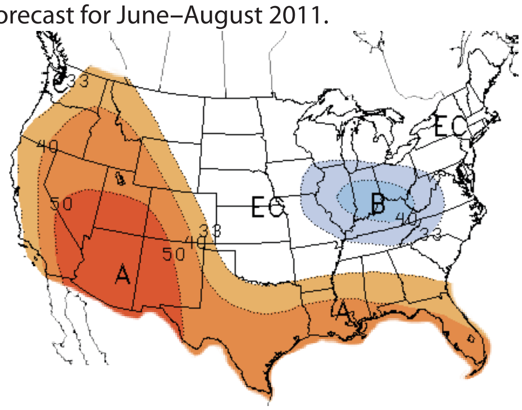
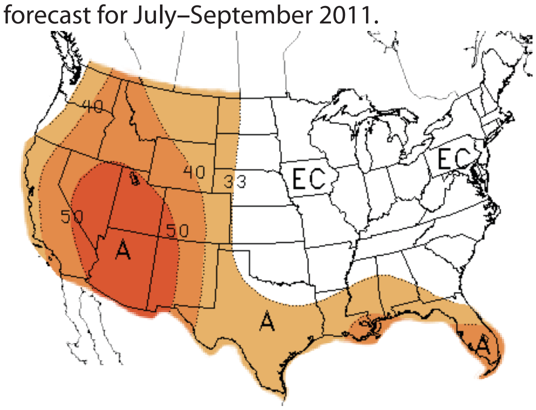


Figure 9d. Long-lead national temperature forecast for July–September 2011.



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

(April 2011–September 2011)

Data Source: NOAA-Climate Prediction Center (CPC)

The NOAA–Climate Prediction Center (CPC) precipitation outlooks suggest drier-than-average conditions for the spring months across most of Arizona and New Mexico (Figure 10a). In spite of the forecasted weakening of La Niña in the spring, very low soil moisture conditions across much of the Southwest may decrease local moisture sources through evaporation and increase the chances for the continuation of below-median precipitation into spring. As we move into the monsoon season, CPC precipitation outlooks call for equal chances for above-, below-, or near-average conditions (Figures 10b–d), primarily because the monsoon season is difficult to forecast this early in the spring. As the monsoon season approaches, more accurate forecasts will be available.

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 2011.

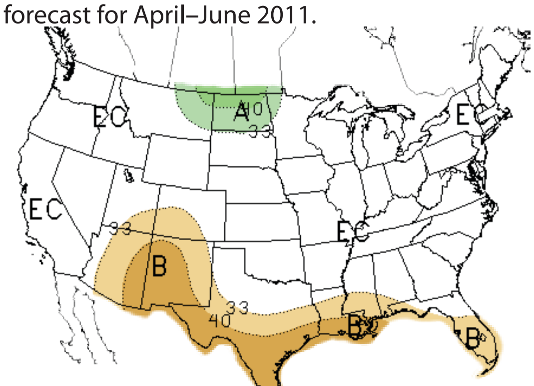
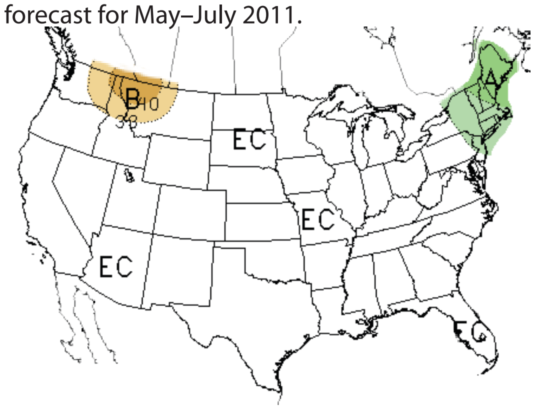


Figure 10b. Long-lead national precipitation forecast for May–July 2011.



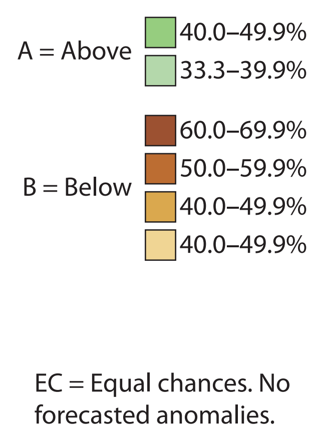


Figure 10c. Long-lead national precipitation forecast for June–August 2011.

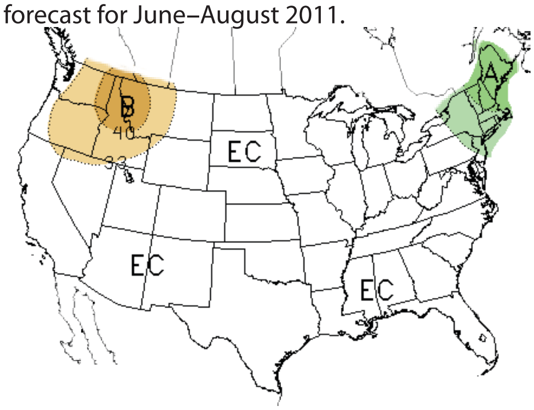
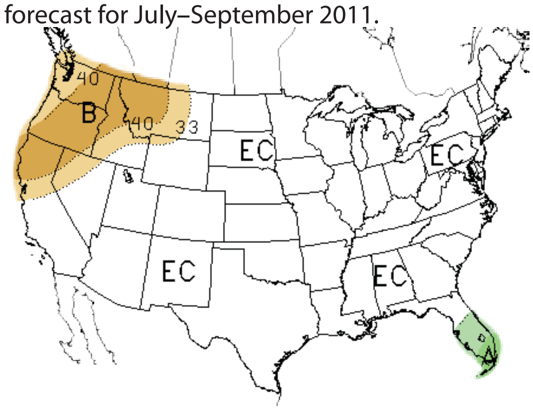


Figure 10d. Long-lead national precipitation forecast for July–September 2011.



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 June)

Data Source: NOAA-Climate Prediction Center (CPC)

This summary is excerpted and edited from the March 17 Seasonal Drought Outlook technical discussion produced by the NOAA–Climate Prediction Center (CPC) and written by forecaster A. Artusa.

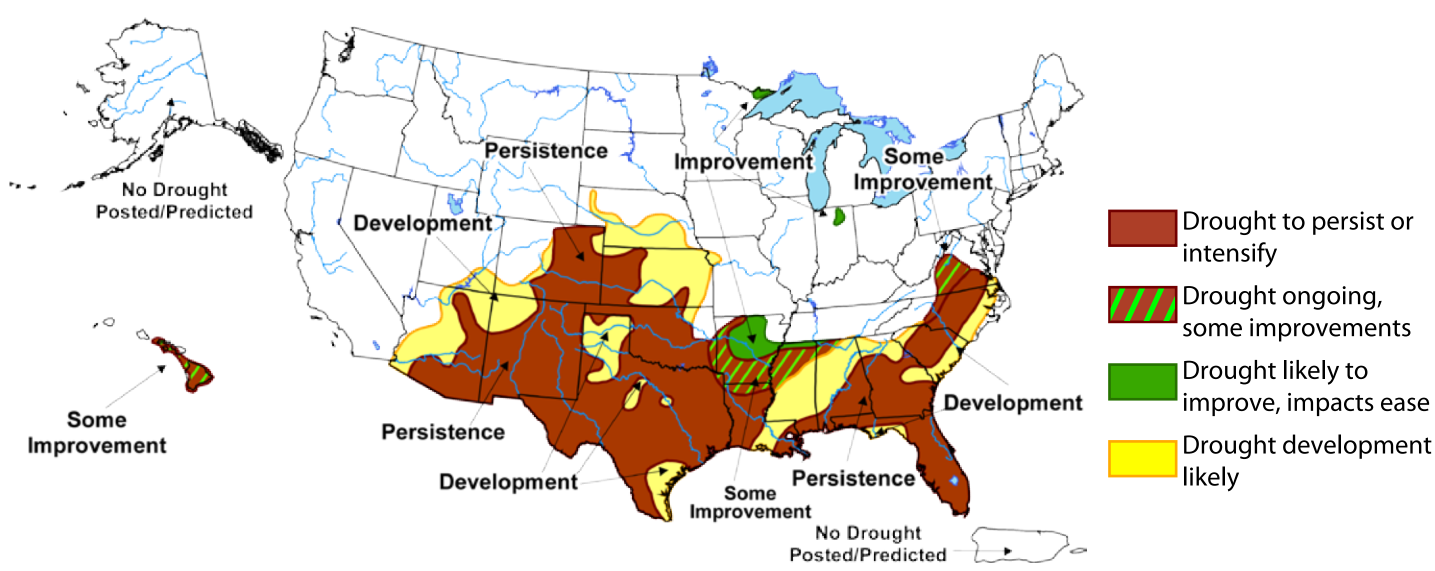
During the past 90 days drier-than-average conditions have affected much of Arizona and New Mexico, with southern portions of these states experiencing deficits between 1.0 and 3.5 inches. Precipitation deficits and depleted soil moisture are typical of La Niña winters, due to the northward displacement of the jet stream and associated storm track. As of March 13, basin-averaged snow water equivalent (SWE) ranged between 25 and 50 percent of average over the southern half of both Arizona and New Mexico. SWC values are considerably closer to average in far northern New Mexico. Changes in drought severity are most noticeable in central New Mexico, which is consistent with historical spring season (April through June) precipitation during a La Niña episode. Based on the climatology of the region, we know that as the year progresses, precipitation will continue to decrease, until the onset of the summer monsoon. For areas already in drought, the seasonal decrease in precipitation may be exacerbated somewhat by lingering La Niña conditions, which support the NOAA–CPC's April-June outlooks (Figures 9 and 10). The outlooks call for enhanced chances of above-average temperatures and below-median precipitation across New Mexico, Arizona, southeastern Utah, and southwestern Colorado. The CPC assigns a high confidence for this forecast (Figure 11).

Elsewhere in the U.S., the La Niña event will continue to impact southern regions, with the exception of Southern California. The monthly and seasonal outlooks issued by the NOAA–CPC indicate the highest odds for below-median precipitation in southern New Mexico and along most southern parts of Texas and Louisiana. Drought is expected to persist or develop across most of the southern Plains and Southeast, except in Alabama, Arkansas, and central Virginia. Medium-range (6-10 day and 8-14 day) forecasts show increased chances of above-median precipitation in Virginia and the Ohio River valley.

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 17).



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

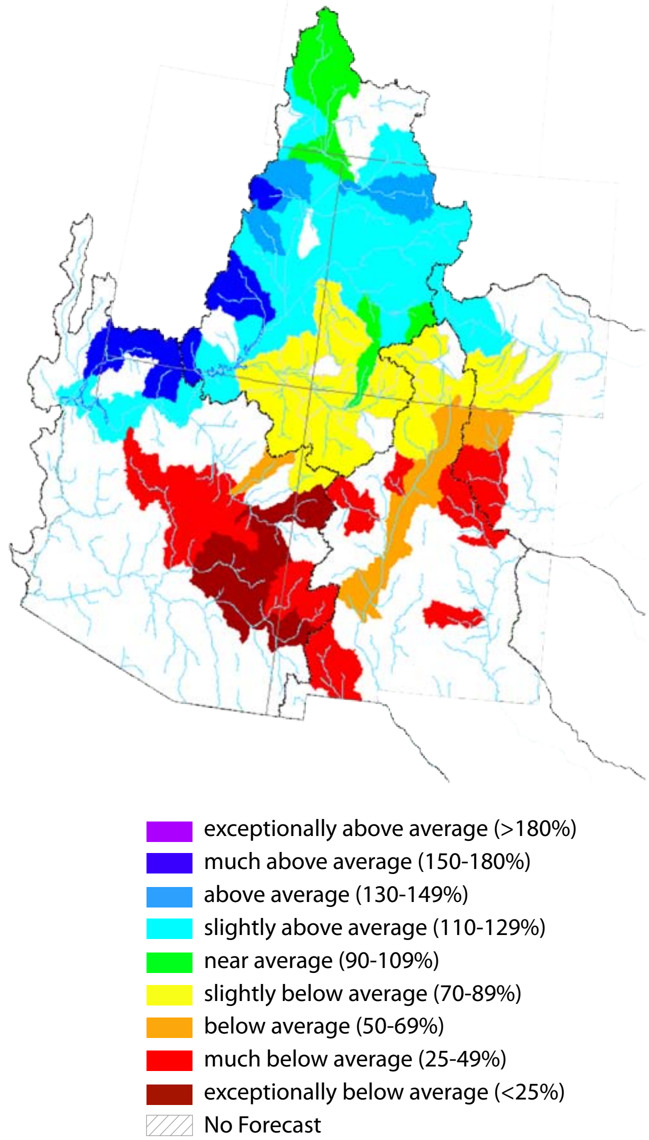
The spring–summer streamflow forecast for the Southwest, issued on March 1, shows below-average flows for basins in the Mogollon Rim region of Arizona and New Mexico basins and near- to above-average flows for most of the Upper Colorado River Basin (Figure 12). Streamflow forecasts become more accurate as the winter progresses. However, spring storms can still have a large effect on actual spring streamflows.

In the Upper Colorade River Basin, winter precipitation has been above average. As a result, there is a 50 percent chance that inflow to Lake Powell will be about 116 percent of the 1971–2000 average for April–July, or 9 million acre-feet, which is a slight increase from the forecast issued on February 1. Dry conditions in most of Arizona are reflected in the streamflow forecast for the state; spring streamflow in the Little Colorado, Verde, Salt and Gila rivers are 18, 42, 22, and 23 percent of median, respectively.

In New Mexico forecasts for the Rio Grande Basin range from 30 percent of average for the Rio Pueblo de Taos below Los Cordovas to 82 percent of average for the El Vado Reservoir inflow. Flows for the Rio Grande at Otowi Bridge are forecast to be around 63 percent of average. For the Canadian River Basin, forecasts range from 40 percent of average for the Conchas Reservoir Inflow to 78 percent of average for Ponil Creek near Cimarron.

Since the water year began October 1, most of Arizona and New Mexico have received below-average rainfall, particularly in southern regions of both states where rain and snow have totaled less than 50 percent of average. The dry southern regions reflect the influence of La Niña events, which often deflect the storms north. In January, most of New Mexico and Arizona received scant precipitation; it was the driest January on record for New Mexico, according to the NOAA-Climate Prediction Center.

Figure 12. Spring and summer streamflow forecast as of March 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 Agriculture'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 March and April, and for New Mexico between March 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

El Niño Status and Forecast

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

La Niña has weakened considerably over the past 30 days but continues to persist at a weak to moderate state. Sea surface temperatures (SSTs) over the eastern and central Pacific Ocean have warmed slightly to just 1.0 degree Celsius below average (up from -1.2 degrees C last month), indicative of weakening La Niña conditions. The atmosphere is lagging the changing SST conditions and continues to show a strong La Niña-like circulation pattern with stronger-than-average easterly winds along the equator and an above-average Southern Oscillation Index (SOI) value for this time of year. (Figure 13a). The International Research Institute for Climate and Society (IRI) notes that it is typical for the atmosphere to lag behind a weakening La Niña evident in warming SSTs, but that the lag should only last for a month or two. IRI also notes that the spring is a challenging time to forecast potential changes in the ENSO conditions for the upcoming spring and summer seasons, but there is growing evidence that the current La Niña event will continue to weaken, yielding to neutral conditions by summer.

Official forecasts produced by the International Research Institute for Climate and Society (IRI) indicate a relative high probability (greater than 75 percent) that La Niña conditions will persist through at least the immediate March-April-May period, but the probability of La Niña persisting past the spring quickly falls off (Figure 13b). By late spring/early summer (May-June-July) the probability of La Niña conditions continuing falls to 30 percent while the chance of ENSO-neutral conditions returning rises to 54 percent. The chance of El Niño conditions returning also rises slightly to 16 percent but remains very low. There is still a good chance that La Niña will continue to impact the weather across the western U.S. through the upcoming spring season.

Notes:

The first figure shows the standardized three month running average values of the Southern Oscillation Index (SOI) from January 1980 through February 2011. 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–January 2011. 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).

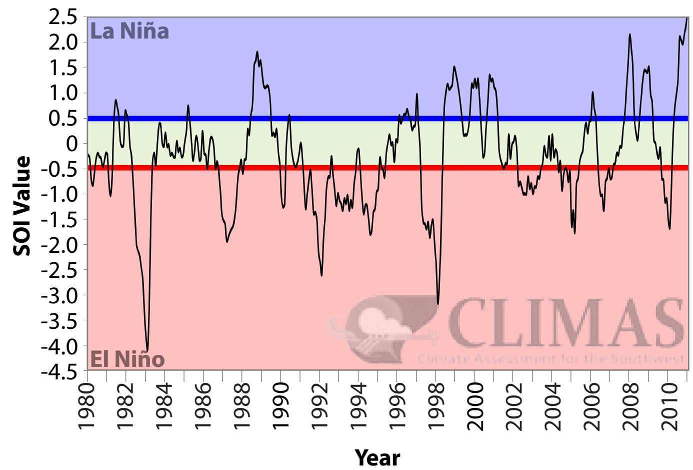
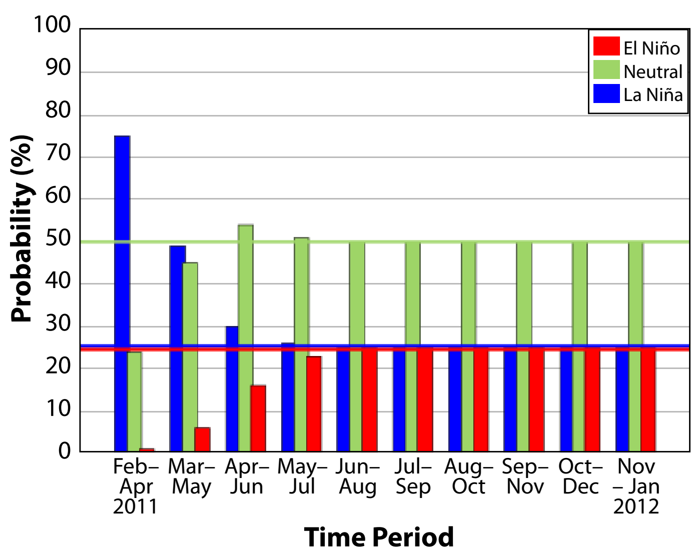


Figure 13b. IRI probabilistic ENSO forecast for El Niño 3.4 monitoring region (released March 17). Colored lines represent average historical probability of El Niño, La Niña, and neutral.



Temperature Verification

(April 2011–September 2011)

Data 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 temperatures for April–June to forecasts issued in March for the same period suggest that forecasts have been substantially more accurate than a forecast of equal chances (i.e., a 33 percent chance that temperatures will be above, below, or near average) in southern Arizona and New Mexico (Figure 14a). Forecast skill—a measure of the accuracy of the forecast—is highest in southeast Arizona and southwest New Mexico. For the May–July period, forecasts have been better than equal chances in all of Arizona and New Mexico, with the highest RPSS values again in southern regions (Figure 14b). For the three-month lead time, forecasts generally have been more accurate in Arizona but not much better than equal chances in New Mexico (Figure 14c). For the four-month lead time, which spans the monsoon season, forecasts have been much more accurate than equal chances in Arizona and less accurate in New Mexico (Figure 14d). While bluish hues suggest that NOAA–Climate Prediction Center (CPC) historical forecasts have been more 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 2011.

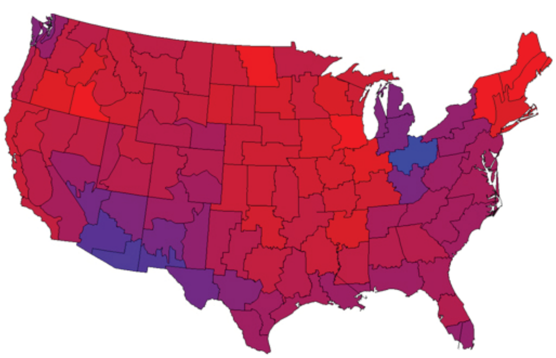


Figure 14b. RPSS for May–July 2011.

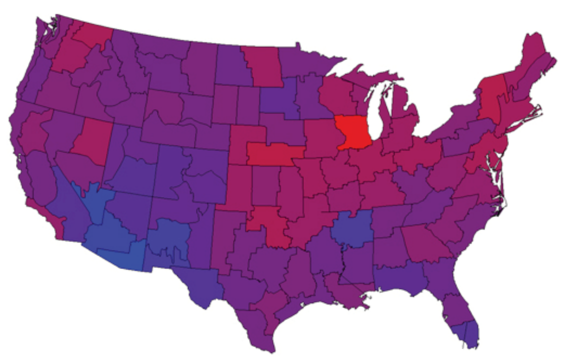


Figure 14c. RPSS for June–August 2011.

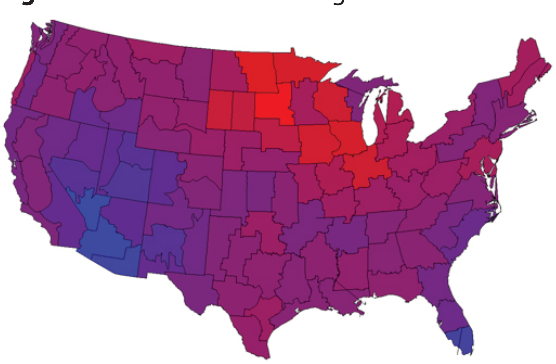
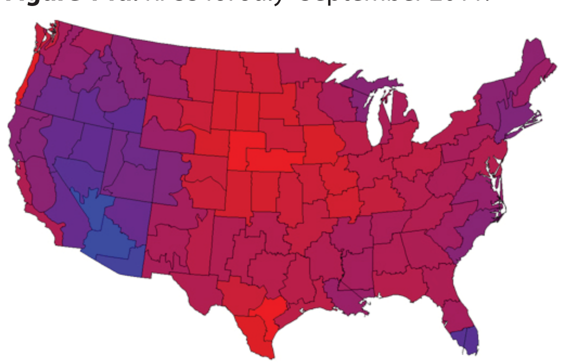
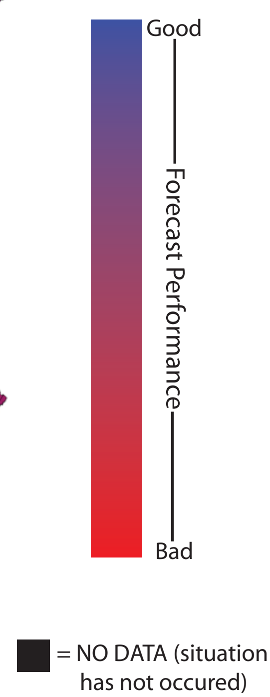


Figure 14d. RPSS for July–September 2011.





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/feature-articles/november-2005

Precipitation Verification

(April 2011–September 2011)

Data 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 have not been more accurate than equal chances in most of Arizona and New Mexico (Figure 15a). Only northwest Arizona has had increased forecast skill—a measure of the accuracy of the forecast, but the value of the RPSS is very low. For the May–July period, forecasts also have not been more accurate than equal chances; most RPSS values are close to zero (Figure 15b). For the three-month lead time, which covers part of the monsoon season, forecasts have about as good as an equal chance forecast (Figure 15c). This implies that the current forecasts for this period do not offer predictive skill. For the four-month lead time, which spans the entire monsoon period, forecasts have been substantially less accurate than equal chances in New Mexico and similar to equal chances in Arizona (Figure 15d). Regions with bluish hues suggest that the NOAA–Climate Prediction Center (CPC) forecasts have historically been more accurate than equal chances. However, caution is advised to users of the NOAA–CPC seasonal outlooks for regions where the verification maps display reddish hues.

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 2011.

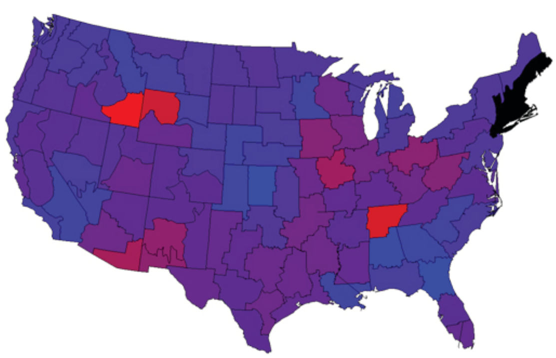
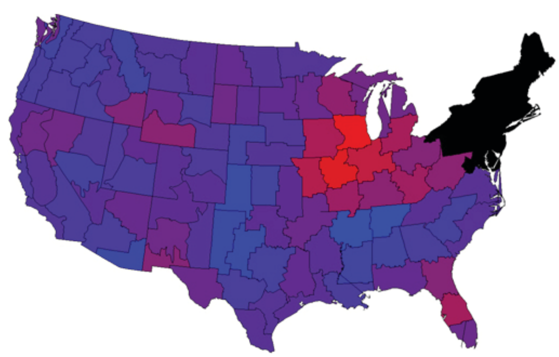


Figure 15b. RPSS for May–July 2011.



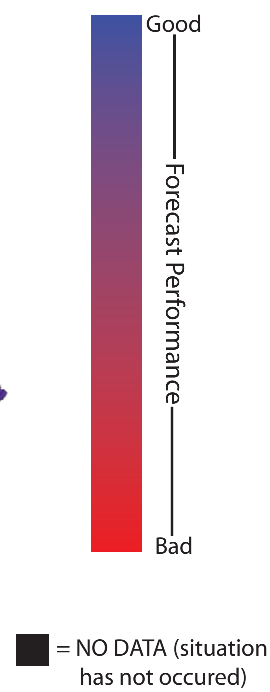


Figure 15c. RPSS for June–August 2011.

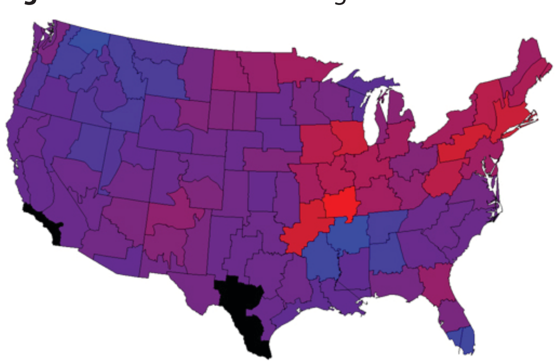
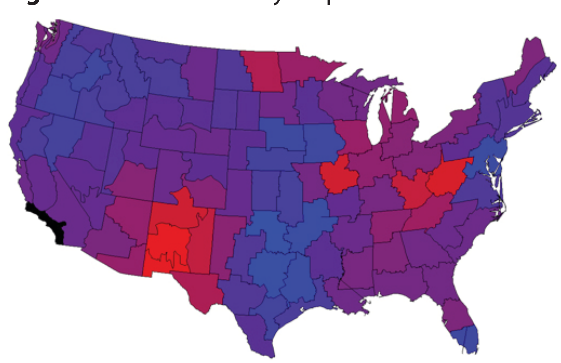


Figure 15d. RPSS for July–September 2011.



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