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Southwest Climate Outlook

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Source: Walter Freeman, UA Graduate Student Physics.

Photo Description: A solitary native cactus bee gathers pollen and nectar from a prickly pear flower in the cactus garden on the University of Arizona Mall.

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
ARIZONA COOPERATIVE EXTENSION THE UNIVERSITY OF ARIZONA • COLLEGE OF AGRICULTURE AND LIFE SCIENCES
ARIZONA
OFFICE OF THE STATE CLIMATOLOGIST
NM STATE UNIVERSITY

April Climate Summary

Drought– Unusually dry weather over the past 30 days has caused short-term drought conditions to continue to expand and increase in severity across much of New Mexico and Arizona, particularly southern regions of both states.

Temperature– Temperatures across the Southwest have been hotter than average in the past 30 days, with most of New Mexico and southeastern Arizona experiencing temperatures more than two degrees warmer than average.

Precipitation– Scant precipitation fell during the winter in most of the Southwest—New Mexico experienced its 6th driest winter of the last 116. That pattern has been upheld in the past 30 days—virtually no precipitation fell in most of New Mexico, while Arizona experienced patches of wetter- and drier-than-average conditions.

ENSO– The La Niña of 2010-11 is coming to an end, with sea-surface temperatures in the equatorial Pacific quickly warming to near-average levels for this time of year. ENSO-neutral conditions are expected to return by early summer.

Climate Forecasts– Forecasts call for a greater than 50 percent chance that temperatures will be above average through the spring and early summer. Equal chances of above-, below-, or near-average rainfall are predicted through the summer.

The Bottom Line–La Niña was the headline of the winter, causing extremely dry conditions in Arizona and New Mexico. Precipitation in many southern parts of both states measured less than 25 percent of the historical average since October 1. January 2011 was the driest on record for New Mexico, and the October–March season was the sixth driest. Snowpacks were also low. However, not all the news is bad. A wet winter in the Upper Colorado Basin is fueling an above-average spring streamflow forecast for the Upper Colorado River, which will help boost storage in lakes Mead and Powell. With the upcoming months historically dry and warm in Arizona and New Mexico, the onus will be on the monsoon to deliver rain and stave the expanding and intensifying drought conditions: 12 and 33 percent of Arizona and New Mexico, respectively, are classified with extreme drought conditions. The dry winter combined with forecasts of continued parched conditions and warmer-than-average temperatures also are fanning an increased risk for wildland fires.

Lake Mead Levels to Rise

The surface of Lake Mead is expected to rise almost 20 feet over the next 10 months, reaching an elevation of about 1,105 feet above sea level by the end of September, according to a Bureau of Reclamation (BOR) press release (April 12). A total of 11.23 million acre-feet of water will flow into Lake Mead this year in part because copious winter snows in the Upper Colorado River Basin have helped elevate spring streamflow forecasts to about 120 percent of average. The wet winter, however, is not the whole reason for increasing storage in Lake Mead. Water managers devised a set of rules for various scenarios outlined in the 2007 Environmental Impact Statement that provide guidelines for managing the basin under drought conditions. Under the rules for 2011 operations, if Lake Powell water elevation is at or above 3,643 feet above sea level and the September 30 projected Lake Mead elevation is below 1,105 feet, BOR must release additional water from Lake Powell to Lake Mead until either the reservoir storages are equal, Lake Mead reaches an elevation of 1,105 feet, or Lake Powell elevation declines by 20 feet below 3,643. These rules also apply for the following years, with slight yearly increases to the 3,643 threshold water elevation for Lake Powell.

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Mike Crimmins,
UA Extension Specialist

Stephanie Doster,
Institute of the Environment Editor

Dan Ferguson,
CLIMAS Program Director

Gregg Garfin,
Institute of the Environment Deputy Director of Outreach

Zack Guido,
CLIMAS Associate Staff Scientist

Gigi Owen,
CLIMAS Assistant Staff Scientist

Nancy J. Selover,
Arizona State Climatologist

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.

Climate Change Poses Challenges to Food Security in the Southwest

By Britain Eakin

This article was published in the Southwest Climate Change Network (SWCCN) on March 2. SWCCN focuses on climate-related issues pertinent to the Southwest region. SWCCN authors catalog and comment on news and science about climate change and related issues relevant to resource managers, utility providers, researchers, policy-makers, and other groups. Read more at http://www.southwestclimatechange.org.

Most of us are familiar with the concept of peak oil, and even peak water. But peak chili peppers? In the southwestern U.S., where the prospects of warmer and drier days loom large, the idea of a dwindling supply of chilies might not be so far-fetched.

The "volume of water available for crop irrigation peaked in the mid-1970s," and "the capacity for water to support cities, industry, agriculture, and ecosystems in the U.S. West is near its limit," according to a recent report on the State of Southwestern Foodsheds.

Combine limited water with the potential effects of climate change (primarily drought and higher temperatures), and food security in the Southwest could face some serious challenges in the coming years. Farmers and families alike will feel the pangs of climate change where it hurts most – in higher prices. The USDA projects a continued trend of rising food prices that outpaces inflation. According to the U.S. Census Bureau 2010 report, Arizona and New Mexico already rank among the worst in the nation in terms of poverty and household food insecurity. This is not good news for southwestern agriculture.

Agriculture plays a major role in the economy of the Southwest. The market value of agriculture products in Arizona and New Mexico tally more than $US 3 and 2 billion, respectively, according to a report on the State of Southwestern Foodsheds.

Veggies in a deep freeze

So how will climate change impact agriculture in the Southwest? One significant aspect of climate change is its impact on the growing season, which in turn can change how agriculture manages irrigation water, according to Hilary Brinegar, a water and natural resource policy specialist with the New Mexico Department of Agriculture.

"You can experience earlier spring runoff than average, which can change the start and end of the growing season from year to year… and you can get more extreme weather events like drought, wind, fire and flood with climate change." Vegetation patterns can also shift due to climate sensitivities, and may cause an increase in non-native species of vegetation and pests, she added.

Severe freezes like the one in mid-February could fall into the category of "more extreme weather events." Most experts say the effects of the recent freeze on agriculture remain to be seen, particularly among pecans and onions. Yet farmers were fortunate the freezes came before most crops had been planted, said Stephanie Walker of New Mexico State University, adding that the prospect of more severe freezes would likely only influence the timing of when crops get planted. In relation to chilies, one of New Mexico's most well-known agricultural crops, Walker said freezes might not be a bad thing.

"I don't think freezes will hurt chili; in some cases it might actually help, because it could reduce winter insect pests. Those pests are used to the normal freezes we get, and bounce back quickly. But a severe freeze could cut down on pest populations

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Food Security, continued

Agriculture near Scottsdale, Arizona.

somewhat, because it would take a little bit longer for them to get reestablished," she said.

Craig Runyan, extension water resource specialist at New Mexico State University, thinks the freeze won't have any significant economic impact on agriculture, with the exception of pecan production. "There will probably be some damage to our pecan orchards, but we may not see it for two or three, maybe even four years because of the nature of freeze damage in deciduous trees—it doesn't show up right away," Runyan said.

High and dry. And warm.
Yet what worries Runyan more now is the drought in New Mexico. Since November of 2010, there has been virtually no precipitation in Las Cruces, New Mexico. "It has not rained here. And where population is growing and demand for water is growing, you just don't know what to do. It's scary," he said.

Indeed, this year looks particularly bad for agriculture in New Mexico.

"Normally southern New Mexico farmers start irrigating around March. But this year they are estimating that they won't start irrigating until later in the summer … mostly due to low reservoir levels and poor snowpack conditions," Brinegar said.

Farmers rely heavily upon snowmelt from the snow pack for irrigation. Snowmelt turns into runoff, which feeds rivers and reservoirs. At some point every year, water gets released from the reservoirs, which farmers can then divert to irrigate their crops. When the runoff is good, farmers can start irrigating in the spring.

According to Brinegar, because of the poor snowpack conditions, the irrigation season is being pushed back this year until the peak demand for water occurs, which happens during the hottest and driest part of the summer, carrying with it economic implications.

"Because of the decreased amounts of surface water (in the reservoirs), farmers will have to pump groundwater to irrigate their crops, a practice that comes with a higher energy cost than diverting out of a river," she said.

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Food Security, continued

"This is going to cost the grower more, the market more… everyone will end up paying more," said Runyan. Rising fuel costs will also drive up food prices. "The post-harvest cost of all food production involves a lot of transportation. It's one of the driving factors in the cost of our food," Runyan added.

The overall picture for the impacts of climate change in the Southwest indicates hotter and drier conditions, said Gregg Garfin, a researcher at the University of Arizona. Brinegar agreed, "We're seeing this trend of moving into what is perhaps longer, more sustained drought. We're at about the 12th year of a sustained drought … so we could be looking at 20 more years of this," she said.

Yet Garfin says the changes we could see are not necessarily straightforward and contain some contradictions. One of the most dramatic impacts could be the change in precipitation patterns.

"Studies at the University of Arizona show that El Niño winters might get wetter, but they will still be hotter," Garfin said. The primary impact of this will manifest in relation to snowpack; more precipitation could come in the form of rain instead of snow.

"Snow is like a time-release capsule for water," Garfin said. "What we want is to have water available during the time of year when we have the most demand for it, and that would be the summer. If snow is melting earlier, or more winter precipitation is coming as rain instead of snow, and therefore not being released more slowly, then we have a less reliable water supply," he added. A less reliable water supply means farmers will increasingly rely upon ground water for agriculture.

What's fairly certain is that the Southwest will see a reduction in winter and spring precipitation, Garfin said. Yet it remains unclear how summer and fall precipitation patterns will differ. "There is a chance summer (monsoon) precipitation will increase, and there is a chance it will become more intense… where it rains down in heavier more intense bursts," he said. Heavy, intense rainfall in short periods of time can flood agricultural fields and destroy crops. Moreover, this increases the chances of hail, which also can damage crops, Garfin said.

Another issue that could arise with drier winter and spring seasons is blowing dust, particularly in the windy months of April, May and June. "You can end up with big dust storms, and the crops literally get pelted with little sand particles – that can just ruin the crops," Garfin added.

All of this could result in big economic losses for Arizona and New Mexico agriculture. The effects of people abandoning agriculture trickle through entire communities, from the folks that sell seed, fertilizer and farm equipment, to stores in small towns and rural areas, Garfin said.

The future of food security

So how will all of this impact food security in the Southwest? That could very well depend on how climate change impacts the regions that export food to Arizona and New Mexico, particularly Mexico, California and South America, Garfin said. According to Peter Warshall's essay in the State of Southwestern Foodsheds report, "Over 95 percent of the food grown within Arizona and New Mexico is exported beyond the boundaries of these two states. Likewise, over 97 percent of the food eaten by residents of Arizona and New Mexico is currently imported."

Yet despite the seriousness of the issue of food security, Garfin also sees positives in some of these problems.

"We might see more community gardens, and people might become more inclined to grow food locally," he said. "We might also see more agricultural growers growing crops for local use rather than for export. In terms of urban areas, there's a movement toward doing more rainwater harvesting, and vertical growing," Garfin said.

Vertical growing pertains to multilevel indoor farms in urban areas that function as large-scale greenhouses, and could offer one possible solution to feeding growing urban populations. Vertical growing could cut down on the transportation costs of importing food, Garfin added.

Whatever the future holds, the State of Southwestern Foodsheds Report indicates that food insecurity will continue to worsen as the effects of climate change on agriculture advance "unless unprecedented measures are taken." The report makes several recommendations targeted specifically to the Southwest, including reducing "the overproduction of certain commodity crops for exports" such as melons, lettuce and chilies; offering "incentives for farmers to grow a broader diversity of crops for local consumption;" increasing access to arable land; and utilizing "fallowed, publically-owned lands for local food production." Additionally, the report advocates for urban food production, growth of less water-intensive crops, and greater consumption of locally grown foods.

Temperature (through 4/20/11)

Data Source: High Plains Regional Climate Center

Temperatures since the water year began on October 1, 2010, averaged between 55 and 65 degrees Fahrenheit in the southwest deserts and along the Arizona–California border, 50 to 55 degrees F in southeastern Arizona and along the southern New Mexico border, 40 to 50 degrees F in central New Mexico, and 30 to 45 degrees F across the Colorado Plateau and northern New Mexico *(Figure 1a)*. Despite some extreme cold events, the Southwest was generally warmer than average this winter *(Figure 1b)*. Temperatures were 0 to 1 degree F warmer than average across the Colorado Plateau and along the Arizona–California border, 0 to 2 degrees F warmer in central Arizona and New Mexico, and 1 to 4 degrees F warmer than average along eastern and south-central New Mexico. In contrast, temperatures in Sierra and Grant counties in southwestern New Mexico and southeastern San Juan County were 0 to 2 degrees F cooler than average. In northwest Arizona, a few extremely cold storms caused the six-month average temperature to fall below average.

Temperatures during the past 30 days also were affected by storms. The warmest areas occurred in regions that experienced the least rainfall, such as southeastern Arizona and southern New Mexico, where temperatures were 2 to 8 degrees warmer than average *(Figures 1c–d)*. The warmest area in southeastern New Mexico also occurred where no storms passed over the past 30 days.

Notes:

The water year begins on October 1 and ends on September 30 of the following year. Water year is more commonly used in association with precipitation; water year temperature can be used to measure the temperatures associated with the hydrological activity during the water year.

Average refers to the arithmetic mean of annual data from 1971–2000. Departure from average temperature is calculated by subtracting current data from the average. The result can be positive or negative.

The continuous color maps (Figures 1a, 1b, 1c) are derived by taking measurements at individual meteorological stations and mathematically interpolating (estimating) values between known data points. The dots in Figure 1d show data values for individual stations. Interpolation procedures can cause aberrant values in data-sparse regions.

These are experimental products from the High Plains Regional Climate Center.

On the Web:

For these and other temperature maps, visit
http://www.hprcc.unl.edu/maps/current/

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

Figure 1a. Water year '10–'11 (October 1 through April 20) average temperature.

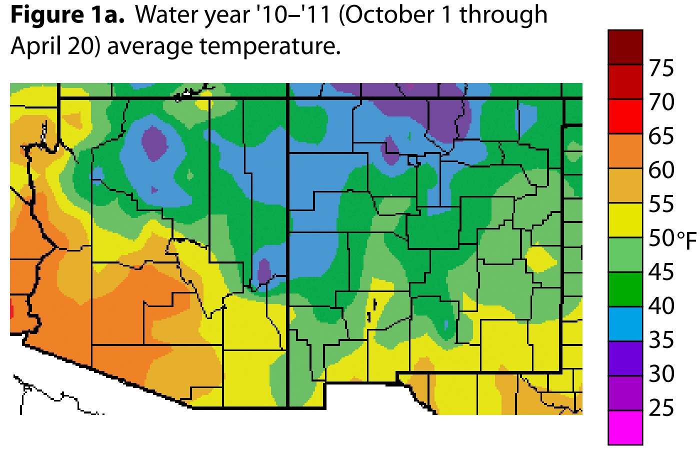


Figure 1b. Water year '10–'11 (October 1 through April 20) departure from average temperature.

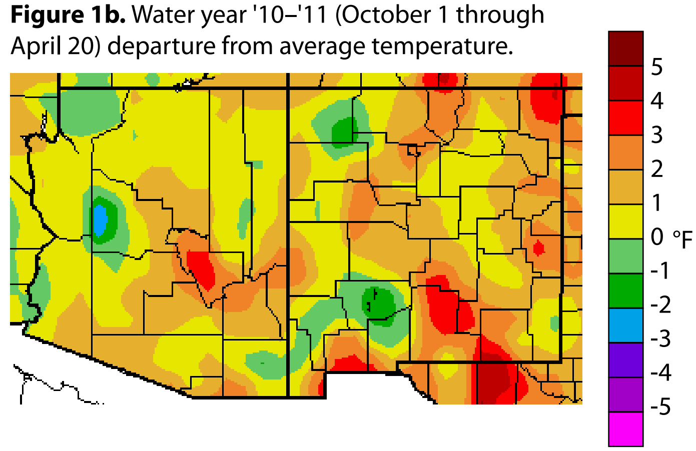


Figure 1c. Previous 30 days (March 22–April 20) departure from average temperature (interpolated).

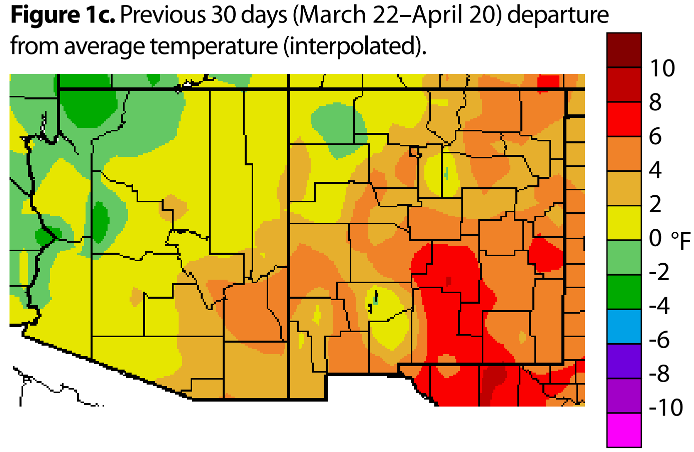
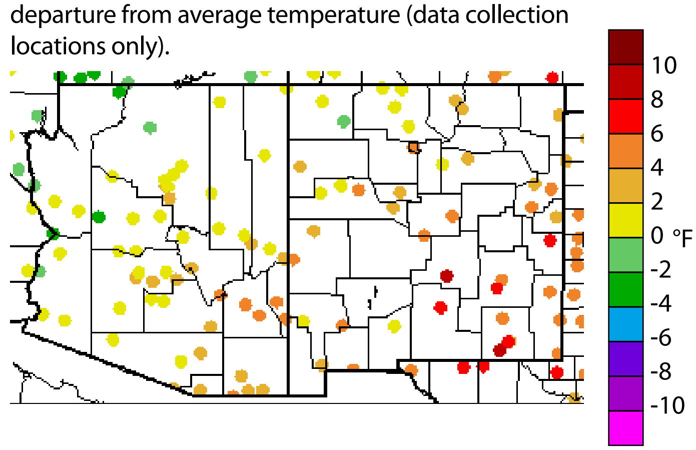


Figure 1d. Previous 30 days (March 22–April 20) departure from average temperature (data collection locations only).



Precipitation (through 4/20/11)

Data Source: High Plains Regional Climate Center

Storm tracks during the winter progressed from southern California northeastward across the northwestern corner of Arizona. Some of the larger storms crossed into central Arizona and a few moved across northern Arizona and northern New Mexico, dropping copious precipitation on higher-elevation locations. The precipitation pattern displayed a strong northwest-to-southwest gradient, ranging from 200–300 percent of average in northwestern Arizona to 50–70 percent of average across central and northeastern Arizona and northern New Mexico, to less than 50 percent of average in southeastern Arizona and eastern New Mexico, and less than 25 percent of average across southern New Mexico *(Figure 2a)*.

The last 30 days brought virtually no precipitation to the southeastern three-fourths of New Mexico, while parts of northwestern New Mexico and southwestern Arizona received above-average rain and snow *(Figures 2c–d)*. The wettest areas, with 100-130 percent of average, are the Sangre de Cristo Mountains in north-central New Mexico and McKinley County, New Mexico. Arizona's wet spots include central Apache, northern Coconino, central Pinal, central and western Pima, and eastern Yuma counties. Most of Cochise County received less than 25 percent of average precipitation during the month. However, even the wettest areas are relatively dry, as rainfall totals across the Southwest have been less than half an inch in the past month.

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 April 20) percent of average precipitation (interpolated).

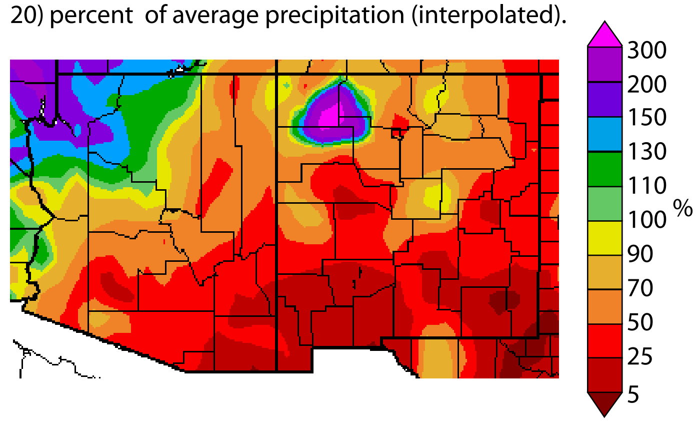


Figure 2b. Water year '10–'11 (October 1 through April 20) percent of average precipitation (data collection locations only).

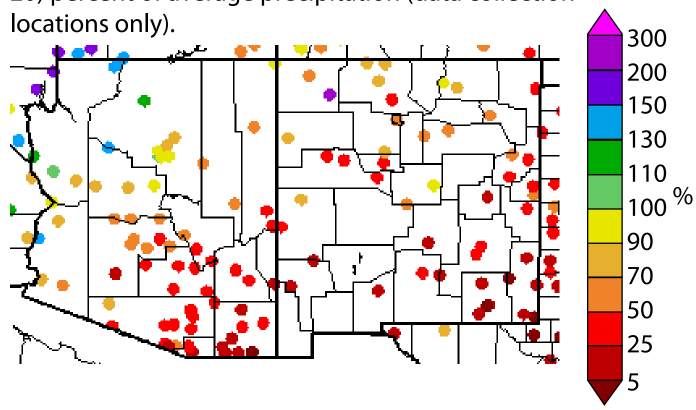


Figure 2c. Previous 30 days (March 22-April 20) percent of average precipitation (interpolated).

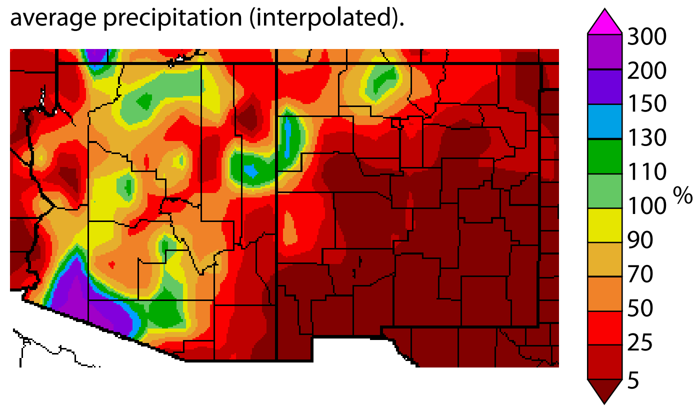
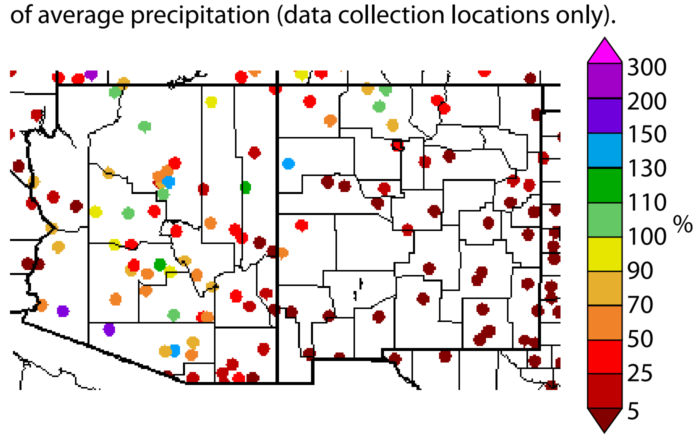


Figure 2d. Previous 30 days (March 22-April 20) percent of average precipitation (data collection locations only).



U.S. Drought Monitor (data through 4/19/11)

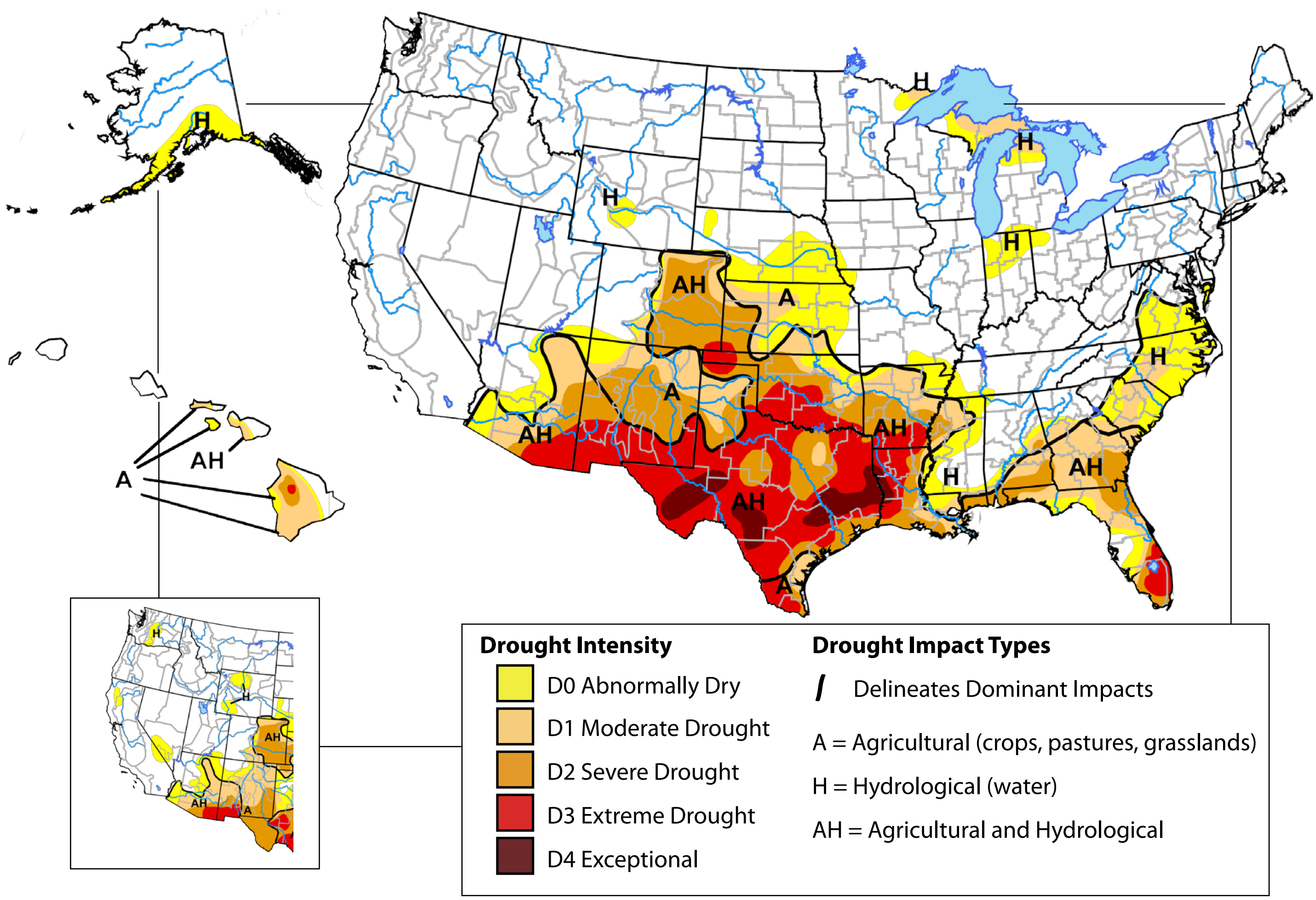
Data Sources: U.S. Department of Agriculture, National Drought Mitigation Center, National Oceanic and Atmospheric Administration

Due to an active and wet storm track this winter, much of the northern two-thirds of the western U.S. remain drought-free. In the past 30 days, precipitation in much of this region measured between 100 and 200 percent of average. Dry conditions, however, plagued much of the Southwest, and during the last 30 days drought conditions worsened in many parts of Arizona, New Mexico, and Colorado. Severe drought conditions expanded in this period across much of eastern Colorado and southern New Mexico, while extreme drought pushed north and west across southeastern Arizona and southern New Mexico. Overall, only 23 percent of the western U.S. is classified with abnormally dry conditions or a more severe drought classification, with 13 percent at the severe to extreme level. A persistent, northerly displaced winter storm track associated with a strong La Niña this winter is largely responsible for the current pattern of drought across the western U.S.

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 April 19 (full size), and March 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

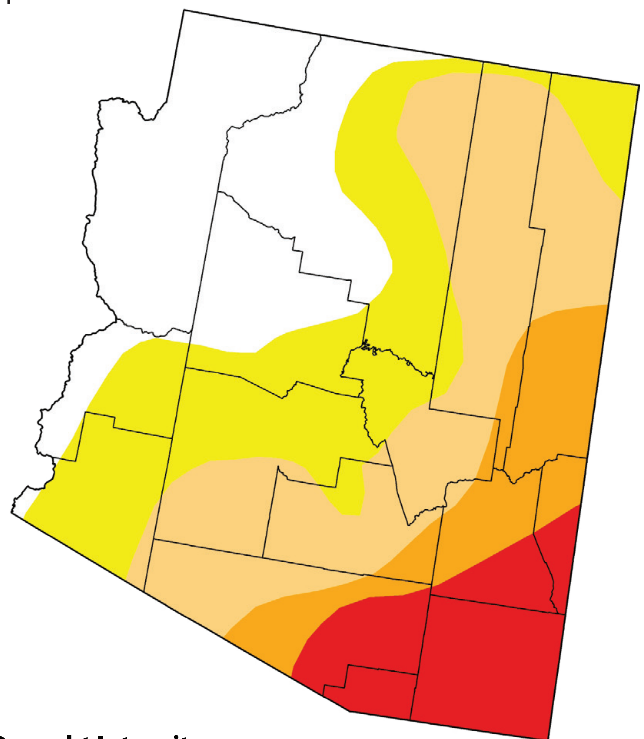
(data through 4/19/11)

Data Source: U.S. Drought Monitor

A few storms passed through Arizona during the past 30 days, but they brought little precipitation to the southern region where precipitation deficits and drought classifications are the highest. According to the April 19, 2011, update of the National Drought Monitor, drought conditions increased and intensified over much of southern Arizona. Severe drought expanded north through Graham, Greenlee, and southern Apache counties, while extreme drought expanded westward through Santa Cruz and eastern Pima counties. Currently, about 50 percent of Arizona is classified with moderate, severe or extreme drought, including about 12 percent as extreme *(Figures 5a–b)*, twice the area of a month ago. Severe drought expanded by about 10 percent statewide over the same period.

Drought impact reports submitted through AZ Drought-Watch (http://azdroughtwatch.org) indicate that short-term impacts such as stressed vegetation and ecosystems are emerging due to the lack of winter precipitation. Range conditions and livestock water resources are also reported as being impacted by extreme drought conditions in the southeast part of the state.

Figure 4a. Arizona drought map based on data through April 19.



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 April 19.

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	25.62	74.38	49.30	22.16	11.73	0.00
Last Week (04/12/2011 map)	25.62	74.38	49.30	22.16	11.73	0.00
3 Months Ago (01/18/2011 map)	40.46	59.54	32.00	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 (04/13/2010 map)	39.37	60.63	14.43	2.66	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 4/19/11)

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

Another exceptionally dry month caused further deterioration of drought conditions across New Mexico. The entire state is currently classified with abnormally dry conditions or a more severe drought category, according the April 19, 2011, National Drought Monitor report *(Figures 5a–b)*. In the past 30 days, drought conditions dramatically intensified across the southern two-thirds of the state, where severe conditions expanded northward and extreme drought expanded north and eastward. About 42 percent of the state is currently classified with severe drought and 33 percent is classified with extreme drought, compared to just 36 and 10 percent, respectively, in mid-March. The National Weather Service in Albuquerque reported that March was the third driest on record over the past 117 years. Statewide, New Mexico has recorded only 30 percent of average precipitation for the past three months, the critical winter wet season. The National Weather Service also reported that widespread fire restrictions are in place across the state in response to the severity of drought conditions.

Figure 5a. New Mexico drought map based on data through April 19.

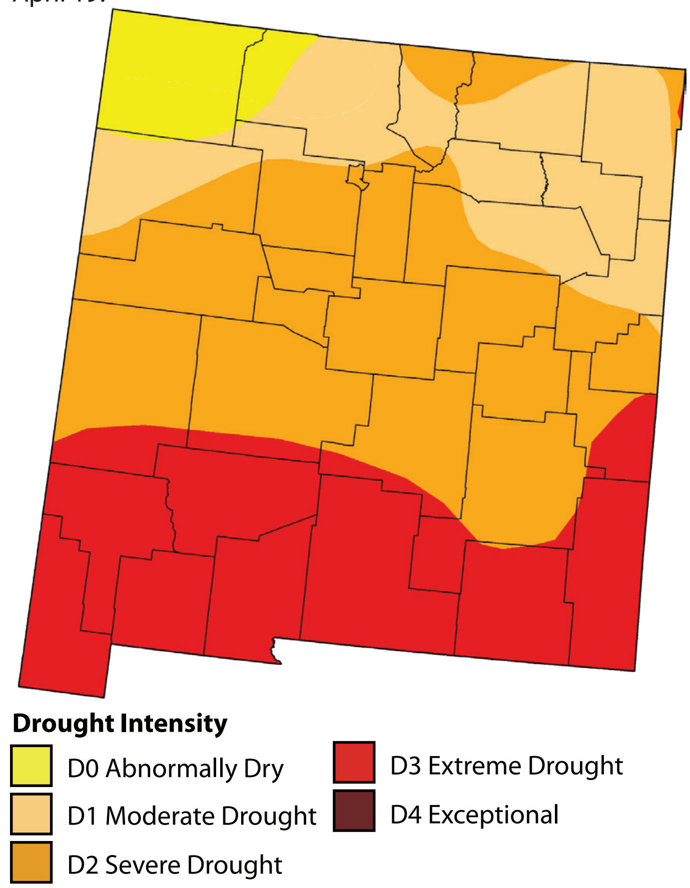


Figure 5b. Percent of New Mexico designated with drought conditions based on data through April 19.

	Drought Conditions (Percent Area)					
	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	0.00	100.00	94.42	74.67	32.65	0.00
Last Week (04/12/2011 map)	0.00	100.00	94.42	74.31	29.47	0.00
3 Months Ago (01/18/2011 map)	8.55	91.45	42.63	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 (04/13/2010 map)	79.00	21.00	0.02	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 3/31/11)

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

During the last month, combined storage in lakes Mead and Powell decreased by 361,000 acre-feet. As of April 1, 2011, combined storage in both lakes was 47.5 percent of capacity *(Figure 6)*, which is 2.5 percent less than a year ago. Due to above-average winter snowpacks in the Upper Colorado River Basin, storage in Powell and Mead is expected to increase during the next several months. Storage in other Arizona reservoirs increased slightly in March, including small increases in the Salt and Verde river basins. The San Carlos Reservoir on the Gila River experienced a decline of 18,600 acre-feet. Total storage in Arizona reservoirs is less than one year ago as a result of dry winter conditions caused in large part by the moderate-to-strong La Niña event.

In water-related news, the city of Payson, Arizona will use a portion of a $10.5 million federal stimulus grant to build a pipeline from Blue Ridge Reservoir near Pine, Arizona to a proposed water treatment plant (The Payson Roundup, April 12, 2011). The 15-mile-long pipeline will ultimately carry 3,000 acre-feet of water to Payson each year, doubling the city's long-term water supply.

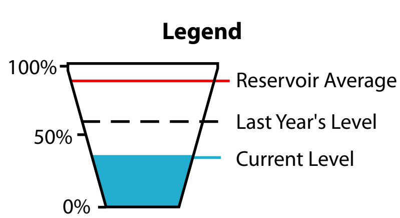
Notes:

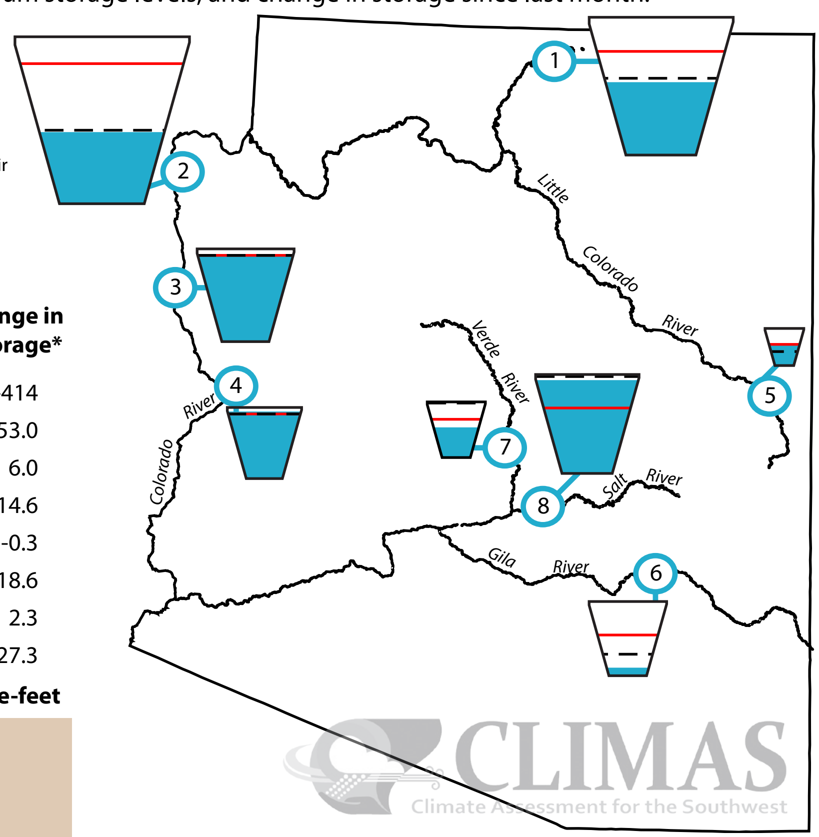
The map gives a representation of current storage levels for reservoirs in Arizona. Reservoir locations are numbered within the blue circles on the map, corresponding to the reservoirs listed in the table. The cup next to each reservoir shows the current storage level (blue fill) as a percent of total 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	53%	12,821.0	24,322.0	-414
2. Lake Mead	43%	11,170.0	26,159.0	53.0
3. Lake Mohave	94%	1,705.0	1,810.0	6.0
4. Lake Havasu	94%	581.2	619.0	14.6
5. Lyman Reservoir	59%	17.7	30.0	-0.3
6. San Carlos	11%	95.0	875.0	-18.6
7. Verde River System	54%	155.4	287.4	2.3
8. Salt River System	94%	1,896.4	2,025.8	27.3

*** thousands of acre-feet**

On the Web:

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

New Mexico Reservoir Levels

(through 3/31/11)

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

The total reservoir storage in New Mexico declined by 48,100 acre-feet in March *(Figure 7)*. Storage in Elephant Butte Reservoir on the Rio Grande decreased by 38,400 acre-feet in the last month, and is about 75,000 acre-feet less than that measured one year ago. Storage in Pecos River basin reservoirs decreased by 14,500 acre-feet in March. New Mexico's largest reservoir, Navajo Lake on the San Juan River, lost only 1,600 acre-feet of storage in March, but now has about two percent less storage, or about 80,000 acre-feet, than one year ago.

In water-related news, Elephant Butte Irrigation District irrigators are facing reduced water deliveries this year due to low Rio Grande runoff (*Albuquerque Journal*, March 31). In addition, farmers in the Rincon Valley near Hatch are expecting this year's chile crop to be impacted as a result of the reduced water allocation (*Las Cruces Sun*, March 28), which may result in as much as a 30 percent increase in the price of chiles.

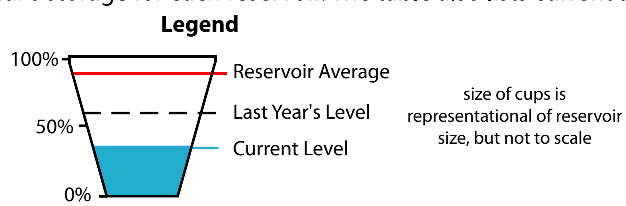
Notes:

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.

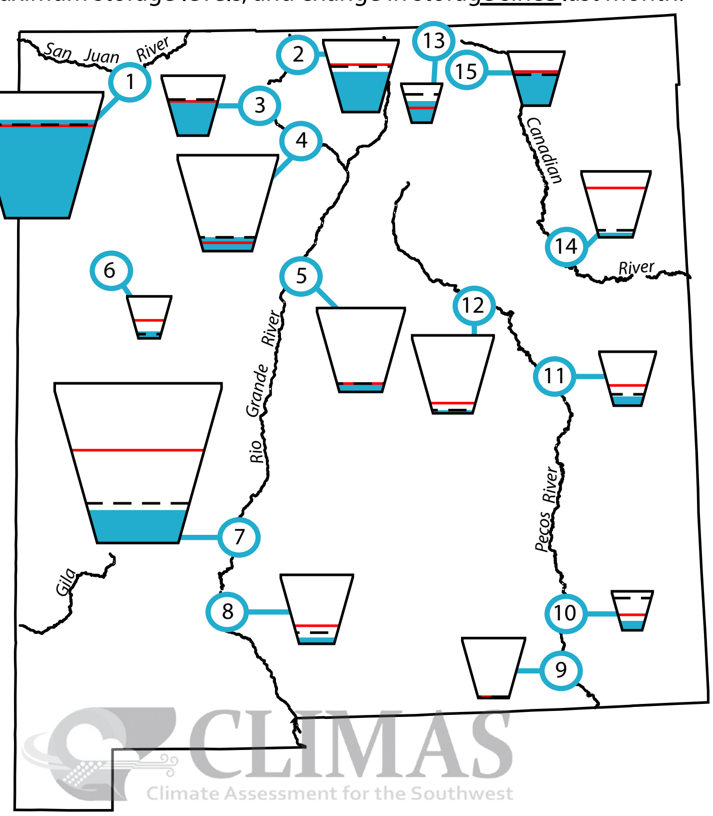
These data are based on reservoir reports updated monthly by the National Water and Climate Center of the U.S. Department of Agriculture's Natural Resource Conservation Service (NRCS). For additional information, contact Wayne Sleep, wayne.sleep@nm.usda.gov.

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%	1,326.1	1,696.0	-1.6
2. Heron	56%	224.3	400.0	-2.4
3. El Vado	57%	108.2	190.3	0.8
4. Abiquiu	15%	174.5	1,192.8	-4.7
5. Cochiti	11%	52.8	491.0	-0.3
6. Bluewater	17%	6.7	38.5	0.1
7. Elephant Butte	21%	466.4	2,195.0	-38.4
8. Caballo	10%	34.1	332.0	9.2
9. Brantley	3%	29.3	1,008.2	14.6
10. Lake Avalon	25%	1.0	4.0	1.7
11. Sumner	17%	16.9	102.0	7.3
12. Santa Rosa	5%	22.5	438.3	-20.1
13. Costilla	56%	8.9	16.0	0.5
14. Conchas	8%	21.6	254.2	-0.7
15. Eagle Nest	66%	52.3	79.0	0.3

*** thousands of acre-feet**



On the Web:

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

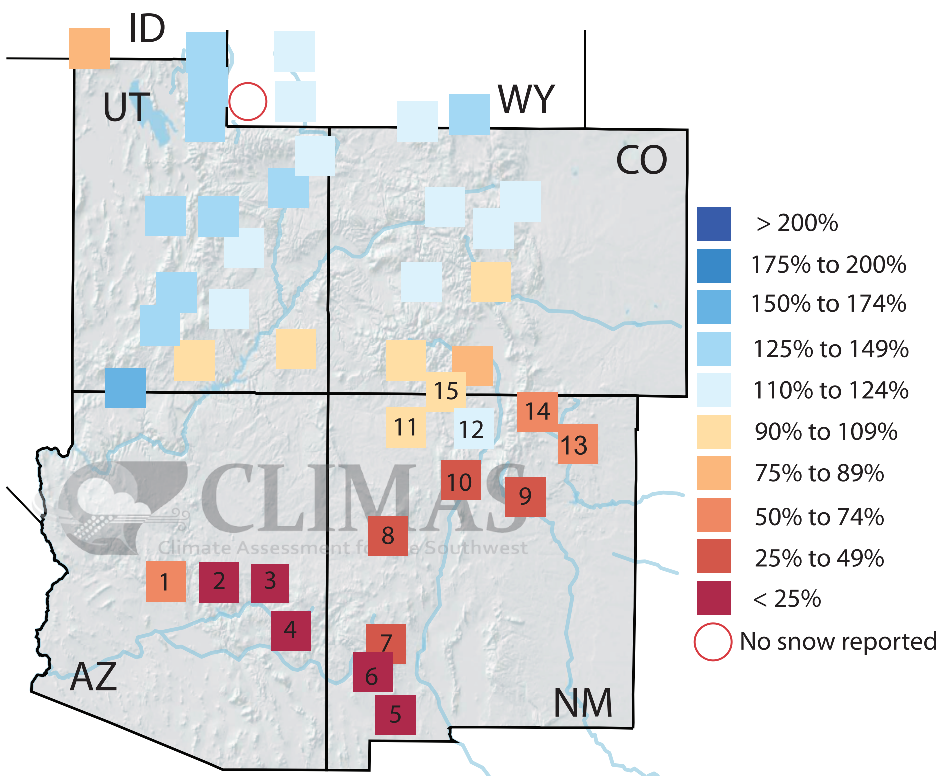
Southwest Snowpack (updated 4/20/11)

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

The volume of water contained in snowpacks, or snow-water equivalent (SWE), across Arizona and New Mexico was below average at almost every snow Telemetry (SNOTEL) as of April 21 *(Figure 8)*. An early April storm boosted snowpacks and precipitation totals in many parts of the Southwest, but most of that snow has melted. Prior to the storm, snow was scant in most of the high country in central and southern Arizona and New Mexico (see last month's Snowpack Summary). The warmer-than-average temperatures predicted for the upcoming month will cause continued and rapid melting. Overall, the October through mid-April SWE for all basins in Arizona was below average, as was the combined basin average for the Salt and Verde river systems.

The moderate-to-strong La Niña event is largely to blame for the dry conditions in the Southwest. However, it also helped deliver above-average snows to the Upper Colorado River Basin states of Utah, Colorado, and Wyoming, from which about 80 percent of the water in the Colorado River originates. As a result, spring streamflow forecasts for Lake Powell predict a 50-percent chance that inflow into the reservoir will be about 120 percent of the 1971–2000 average. Spring streamflow forecasts for other Arizona and New Mexico rivers all call for below-average discharge, with some rivers likely to flow at less than 50 percent of average. Forecasts for the Rio Grande, for example, indicate a 50-percent chance that streamflow at Otowi Bridge will be only 48 percent of average for the April–July period.

Figure 8. Average snow water equivalent (SWE) in percent of average for available monitoring sites as of April 20.



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
(May 2011–October 2011)

Data Source: NOAA-Climate Prediction Center (CPC)

The seasonal temperature outlooks issued by the NOAA–Climate Prediction Center (CPC) in April call for increased chances for temperatures to be similar to those of the warmest 10 years of the 1971–2000 period through the spring and summer. For the May–July period, CPC outlooks call for greater than a 50 percent chance that temperatures will resemble the warmest years in the climatological record in most of Arizona and New Mexico *(Figure 9a)*. These forecasts are based in part on the continuation of the La Niña event—which is currently weakening—and low soil moisture levels. For forecasts issued for the two-, three-, and four-month lead-times, temperatures in nearly all of Arizona and the western and southern portions of New Mexico have greater than a 40 percent probability of being similar to those of the warmest 10 years in the climatological record, with most of Arizona having probabilities greater than 50 percent *(Figures 9b–d)*.

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 May–July 2011.

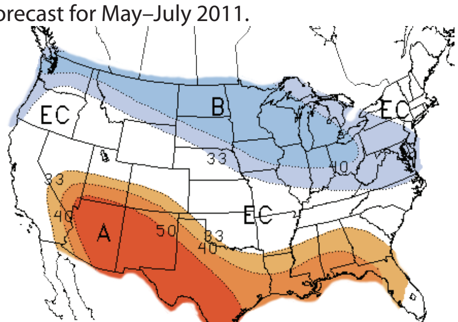
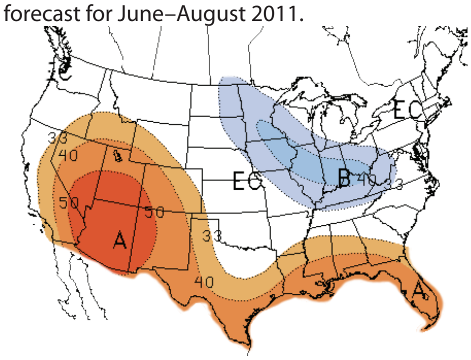


Figure 9b. Long-lead national temperature forecast for June–August 2011.



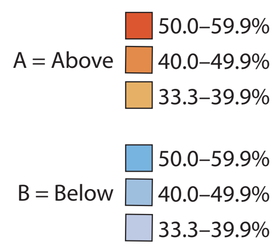


Figure 9c. Long-lead national temperature forecast for July–September 2011.

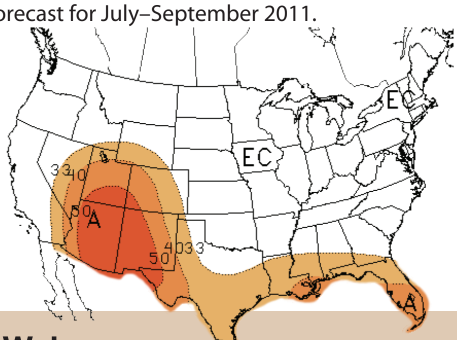
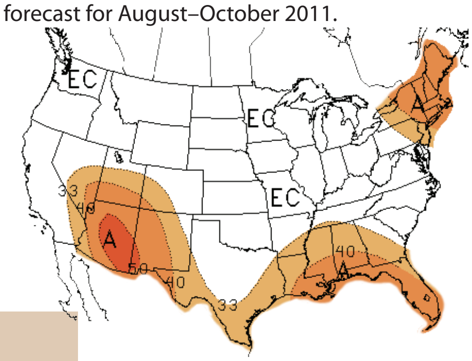


Figure 9d. Long-lead national temperature forecast for August–October 2011.



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
(May 2011–October 2011)
Data Source: NOAA-Climate Prediction Center (CPC)

The NOAA–Climate Prediction Center (CPC) forecasts equal likelihood of near-average, above-average, and below-average precipitation in the Southwest during through October *(Figures 10a–d)*. This equal chances forecast is based in part on the difficulty in projecting the monsoon, which typically begins around July 1 and ends in late September. As the monsoon approaches, more accurate forecasts will be available. In the mean time, there is some indication that the spring and summer will continue to be warm and dry: the very low soil moisture conditions that extend across much of the Southwest may reduce the amount of water vapor returned to the atmosphere by evaporation, limiting storm formation. The current soil conditions result from the La Niña-influenced dry winter.

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 May–July 2011.

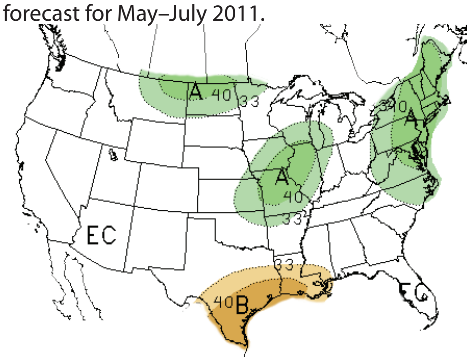


Figure 10b. Long-lead national precipitation forecast for June–August 2011.

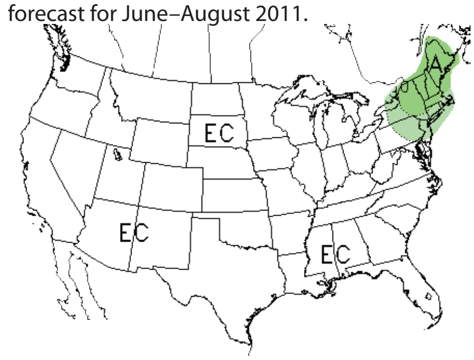


Figure 10c. Long-lead national precipitation forecast for July–September 2011.

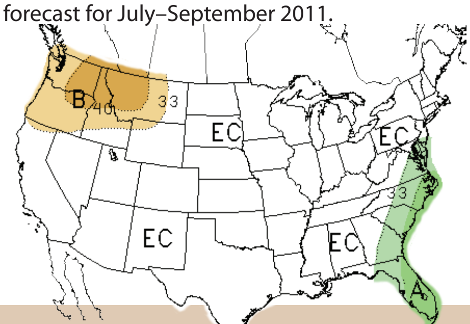
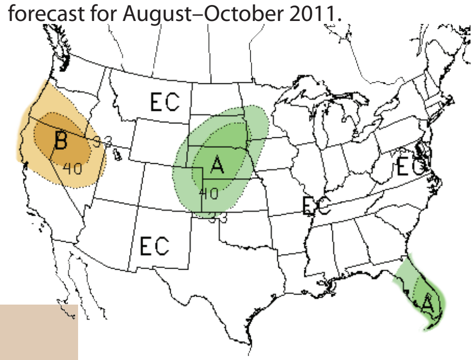


Figure 10d. Long-lead national precipitation forecast for August–October 2011.



A = Above: 40.0–49.9%; 33.3–39.9%

B = Below: 60.0–69.9%; 50.0–59.9%; 40.0–49.9%; 40.0–49.9%

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
(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 April 21 Seasonal Drought Outlook technical discussion produced by the NOAA–Climate Prediction Center (CPC) and written by forecaster B. Pugh.

The La Niña event caused drought conditions to worsen across eastern Arizona, eastern Colorado, and New Mexico. Southern parts of Arizona and New Mexico are classified under extreme drought. Basin average snow-water content is running less than 25 percent of average across much of Arizona. The drought forecast for Arizona calls for the persistence, intensification, and development of drought *(Figure 11)* because the snow-water content in the mountains is very low, the upcoming season is historically dry, and precipitation and temperature forecasts issued by the NOAA–Climate Prediction Center (CPC) indicate enhanced chances for below median precipitation and above-average temperatures for the forecast period. In New Mexico, the forecast also calls for persistence and intensification of drought conditions, including new drought development in the northwest corner of the state, the only region still void of a drought category.

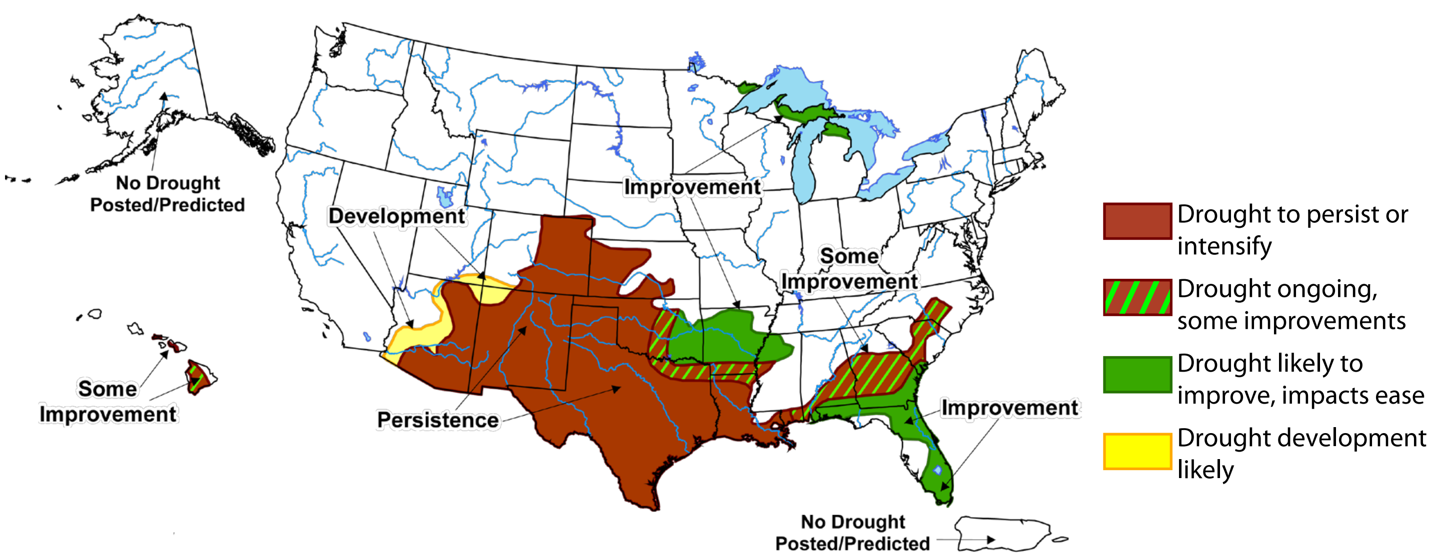
The NOAA–CPC has high confidence in the Arizona forecast and moderate confidence New Mexico forecast.

Elsewhere, dry weather combined with hot temperatures, gusty winds, and low relative humidity resulted in rapidly intensifying drought conditions across Texas. As of April 12, more than 60 percent of Texas is designated as under extreme or exceptional drought, the largest coverage of these combined categories in the state since the inception of the U.S. Drought Monitor in January 2000. Numerous, large wildfires are burning across the state. While precipitation forecasts for the next two weeks favor some improvement in drought conditions in northeast Texas, drought persistence across south and southeast Texas is consistent with the NOAA–CPC outlooks which indicated increased odds for below-median precipitation.

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 April 21).



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

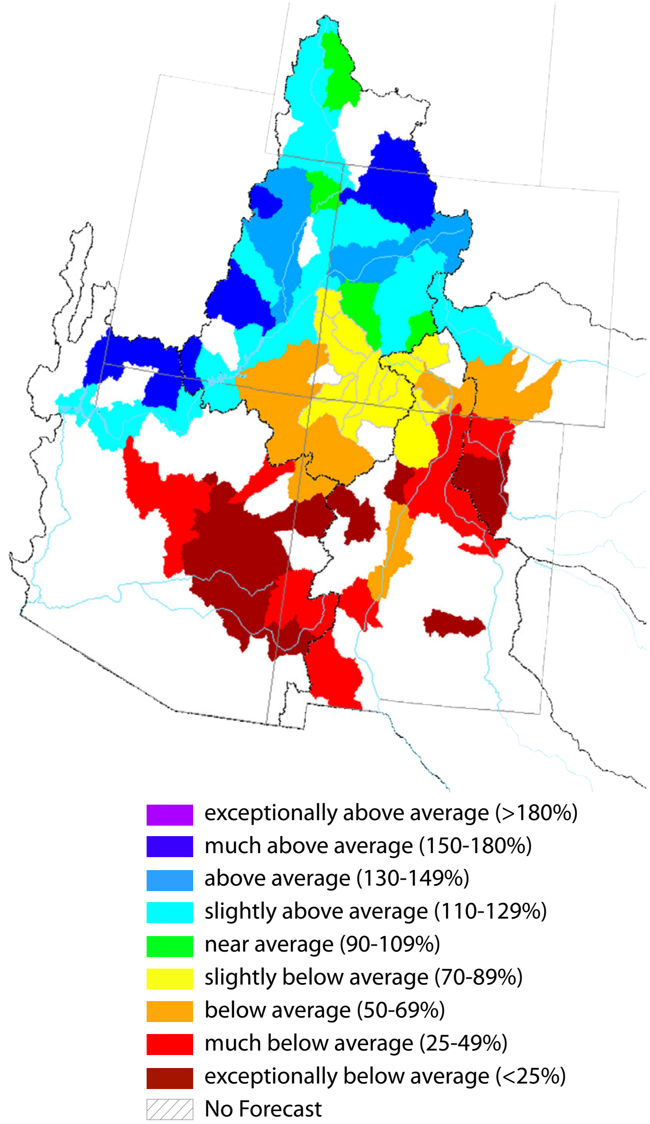
Streamflow Forecast
(for spring and summer)
Source: National Water and Climate Center

Last winter's La Niña event left a dry imprint on the Southwest. The spring–summer streamflow forecast issued by Natural Resources Conservation Service for the Southwest issued on April 1 predicts 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)*. These forecasts are based principally on snow accumulation in the mountains from which most of the water originates. Precipitation during March was well below normal throughout all basins in Arizona and New Mexico. In Arizona, snowpack levels were well below average in all of the basins as of April 1, with most measurement sites void of snow. A winter storm in early April boosted snowpack and precipitation totals in many basins in the Southwest, including the Upper Colorado River Basin, resulting in higher streamflow projections for the Colorado River.

The April 1 forecasts projects a 50 percent chance that inflow to Lake Powell will be about 120 percent of the 1971–2000 average for April–July, or 9.5 million acre-feet, an increase over last month's forecast of 113 percent of average. Forecasts for the Salt and Upper Gila rivers, on the other hand, call for very low probabilities that flows will be near average. Forecasts indicate a 50 percent chance that streamflow in the Salt and Verde rivers during the April–May period will be equal to or less than about 15 and 43 percent of average, respectively.

In New Mexico, the April 1 forecast shows the majority of the state on pace for well below-average runoff. Forecasts indicate a 50 percent chance that the Rio Grande streamflow at Otowi Bridge will be only 48 percent of average for the April–July period. Forecasts for the Upper Gila and Pecos rivers call for a 50 percent chance that streamflow will be at or below 23 and 35 percent, respectively, for the same period.

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 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 and http://www.cbrfc.noaa.gov

Wildland Fire Outlook

(May–July 2011)

Sources: National Interagency Coordination Center, Southwest Coordination Center

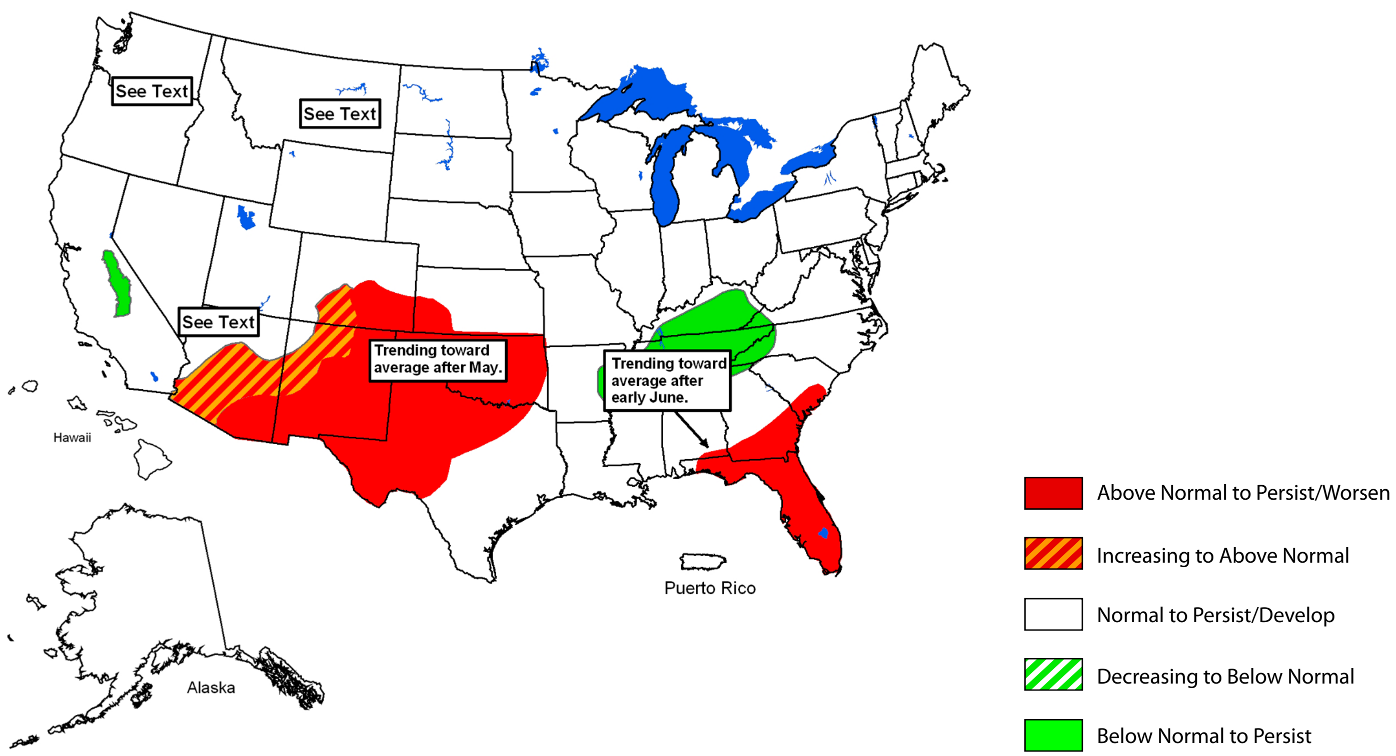
The moderate-to-strong La Niña event, which is currently weakening, pushed most storms north of Arizona and New Mexico this winter. As a result, the landscape is parched in many regions of the Southwest. Looking ahead, forecasts call for below-average precipitation, above-average temperatures, and expanding and intensifying drought conditions in the next several months. The current conditions, couple with these forecasts, have led the Predictive Services at the National Interagency Fire Center to call for above-normal significant fire potential in the Southwest. Significant fire potential is the likelihood that a wildland fire event will require additional fire management resources from outside the area in which the fire originated. According to Predictive Services, dry conditions and above-normal fire potential will expand north and west during the May–July period, covering almost all of New Mexico and about two-thirds of Arizona *(Figure 13)*. Lightning-ignited fires typically peak in early to mid June.

Conditions might improve in mid to late May and June in southeastern New Mexico if moisture moves in from the southeastern U.S. It is unclear if the monsoon season will begin early and deliver above-average rainfall to the region—the monsoon typically begins around the first week in July for southern regions of Arizona and New Mexico. The NOAA–Climate Predictions Center currently is forecasting neither a strong nor weak monsoon.

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 2011).



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)

La Niña continued to weaken over the past 30 days and is only hanging on by a thread at this point. Sea surface temperatures have warmed considerably across the equatorial Pacific Ocean and currently are only 0.6 degrees Celsius (about 1 degree Fahrenheit) below average in the eastern Pacific, where a large area of warmer-than-average water has been accumulating just below the surface. These conditions indicate that La Niña is severely diminished and neutral conditions will soon return. The International Research Institute for Climate and Society (IRI) notes that the atmosphere has not yet responded to the recent increases in sea surface temperatures and is still behaving as if a strong La Niña event were present, with above-average easterly winds along the equator and a highly positive Southern Oscillation Index (SOI) *(Figure 14a)*. But the atmospheric response to changes in sea-surface temperatures is typically delayed. A weak La Niña event is expected to continue for the next month or two, with neutral conditions likely returning by early summer. IRI forecasts predict a greater than 50 percent chance that neutral conditions will return during the May–July period, with only a 27 percent chance that La Niña conditions will persist and a 15 percent chance that an El Niño will develop *(Figure 14b)*. There is a slight increase in the odds for development of an El Niño later this summer. La Niña impacts on land may linger for several months, but will probably be of little consequence to Arizona and New Mexico, as May and June are historically hot and dry anyway.

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 14a. 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).

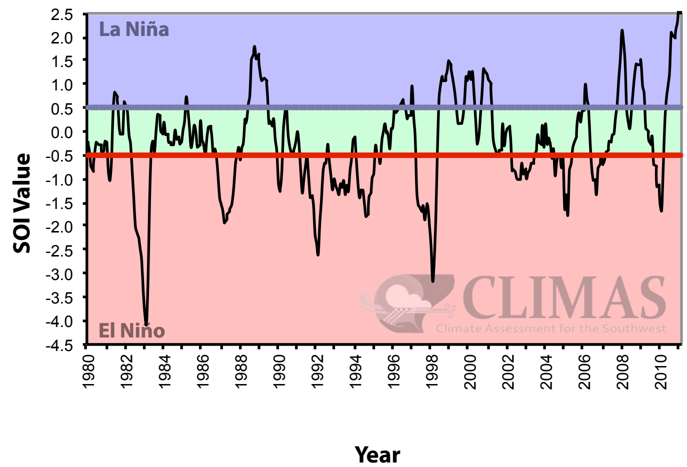
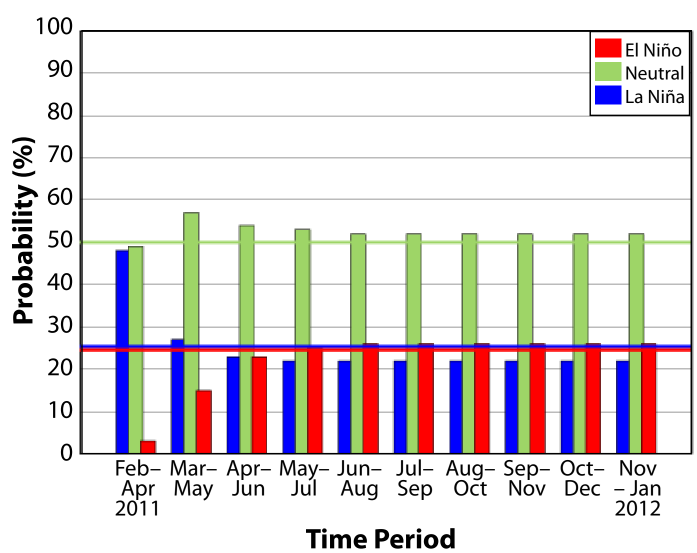


Figure 14b. IRI probabilistic ENSO forecast for El Niño 3.4 monitoring region (released April 21). Colored lines represent average historical probability of El Niño, La Niña, and neutral.



Temperature Verification
(May 2011–October 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 May–July to forecasts issued in April 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 *(Figure 15a)*. NOAA–Climate Predictions Center forecasts for this season are based in part on recent trends in warming for this season. For the June–August period, forecasts have been better than equal chances in most of Arizona and about as good as equal chances in New Mexico *(Figure 15b)*. For the July–September period, forecasts generally have been more accurate in Arizona and less accurate than equal chances in New Mexico *(Figure 15c)*. For the four-month lead time, forecasts have been much more accurate than equal chances only in parts of Arizona *(Figure 15d)*. 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 15a. RPSS for May–July 2011.

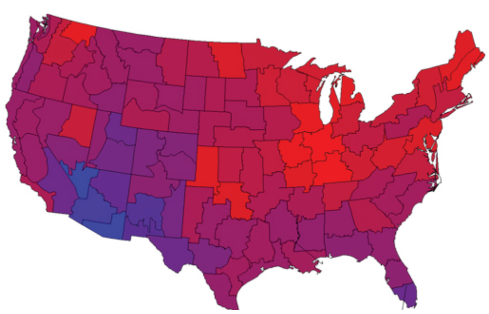


Figure 15b. RPSS for June–August 2011.

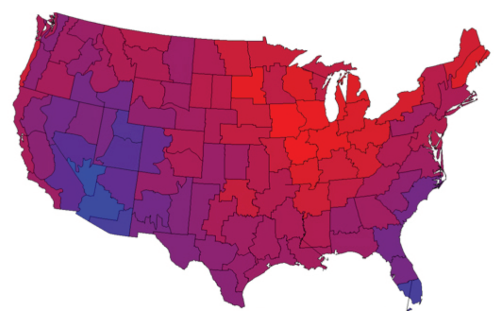


Figure 15c. RPSS for July–September 2011.

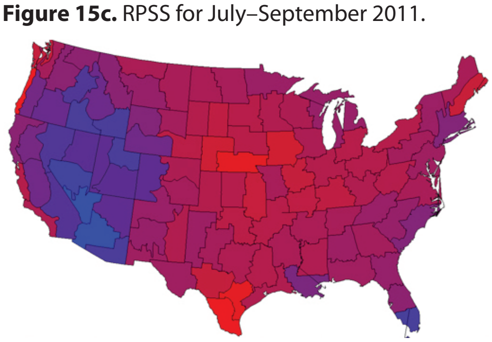
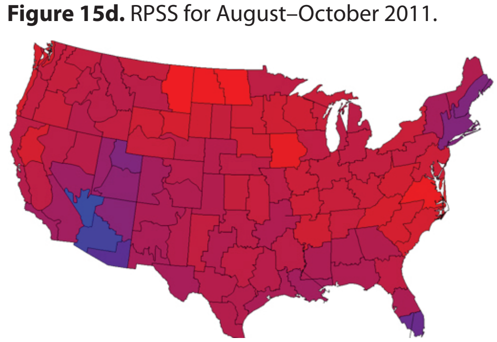
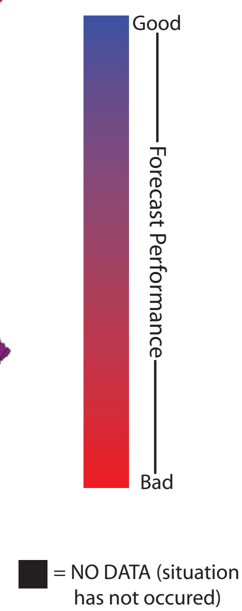


Figure 15d. RPSS for August–October 2011.





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
(May 2011–October 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 May–July to forecasts issued in April for the same period suggest that forecasts are slightly more accurate than equal chances in all of Arizona and New Mexico *(Figure 16a)*. While all regions have positive Rank Probability Skill Score (PRSS) values, they are very low, indicating that the historical accuracy of the forecasts have only been marginally better than equal chances. For the June–August period, forecasts for both states have historically been no more accurate than equal chances; most RPSS values are close to zero *(Figure 16b)*. For the July–September period, which covers the monsoon, forecasts have less accurate than equal chances, especially in regions most influenced by the monsoon, such as southwest New Mexico and southeast Arizona *(Figure 16c)*. This implies that the current forecasts for this period may not be a useful tool for decision-making. For the four-month lead time, which also spans part of the monsoon period, forecasts have been similar to or less accurate than equal chances in both states *(Figure 16d)*. 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 16a. RPSS for May–July 2011.

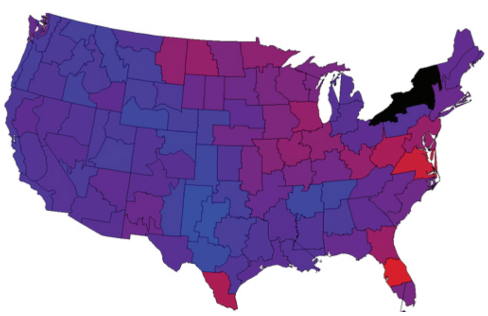
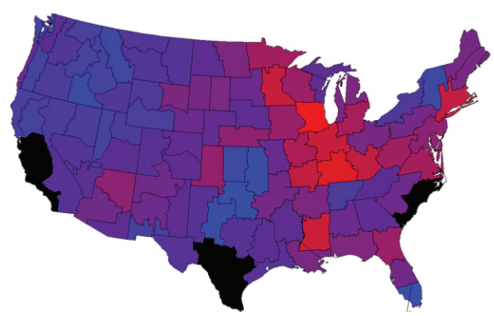


Figure 16b. RPSS for June–August 2011.



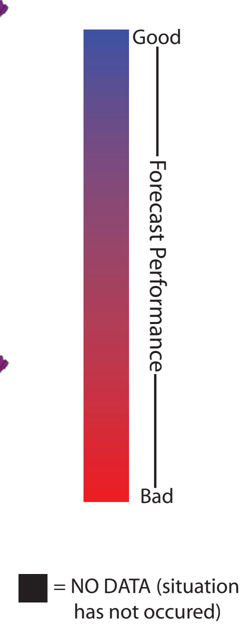


Figure 16c. RPSS for July–September 2011.

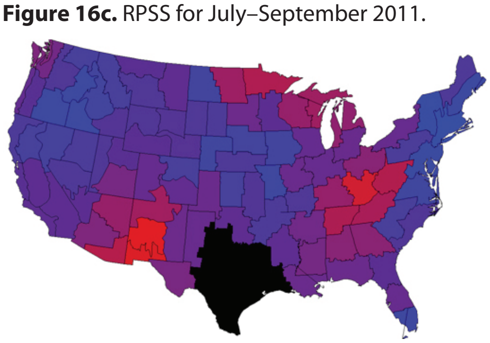
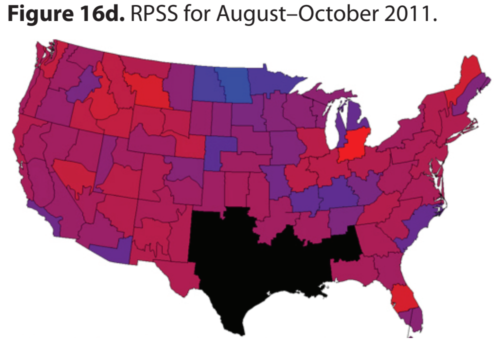


Figure 16d. RPSS for August–October 2011.



On the Web:

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

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