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Southwest Climate Outlook

THE UNIVERSITY OF ARIZONA.
Arizona's First University.

Source: Dan Ferguson, CLIMAS. May, 2009.

Photo Description: Sheets of rain soak Hopi villages on Second Mesa in Northeast Arizona in May.

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In this issue...

July Climate Summary

Drought – Monsoon rains have helped ease drought conditions in Arizona, particularly in the southeast region. The rains also have helped New Mexico, decreasing the extent of moderate and severe drought conditions.

Temperature – Only a few areas in western New Mexico and southern Arizona have had below-average temperatures.

Precipitation – Predictions of an early and wet monsoon have come true for central and southeast New Mexico and south-central Arizona.

ENSO – The NOAA-Climate Prediction Center has officially declared an El Niño event. El Niño conditions are expected to continue to develop during the next several months, evolving into a weak to moderate event that lasts through the 2009–10 winter.

Monsoon – The forecast for the 2009 monsoon called for an early start to the rainy season accompanied by above-average precipitation for the first half of the season. After the first month of rains, the forecast appears to have been accurate.

Climate Forecasts – Late summer and fall forecasts for much of the Southwest indicate temperatures similar to the warmest 10 years of the 1971–2000 observed conditions. Forecasters are uncertain about summer to fall precipitation because El Niño events can either increase or decrease rainfall.

The Bottom Line – The monsoon season so far has lived up to expectations, arriving early and with above-average rains in some parts of both states. However, because the past few monsoon seasons have been very wet, this season may seem dry. August storms are expected to deliver more rain to the parched Four Corners region, and rains elsewhere will continue to improve short-term drought conditions.

Wet or Dry in the Second half of the Monsoon Season?

El Niño's impact on the Southwest will be felt, it's just not yet clear how. The forecasts issued by the NOAA-Climate Prediction Center (NOAA-CPC) calls for equal chances that August–October precipitation will be above-average, below-average, or average for all of Arizona and the southwestern half of New Mexico (see Figure 11a). Forecasters are uncertain because of a rapidly forming El Niño event in the tropical Pacific Ocean, which often is associated with two phenomena that have opposite effects on precipitation in the Southwest. On one hand, El Niño events can stifle summer rains in Arizona and New Mexico because they weaken and/or reposition the subtropical high that guides moisture into the Southwest. On the other hand, El Niño events also can foment a higher number of tropical storms, some of which deliver copious rains to the Southwest. While the first month of the monsoon season followed predictions, exhibiting an earlier-than-average onset and above-average precipitation for many parts of Arizona and New Mexico, forecasters are more hesitant to predict what's next. "We'll have to wait and see," said Erik Pytlak, science and operations officer for the National Weather Service in Tucson. "It's going to be interesting."

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Who's paying attention to the drought on the Colorado Plateau?

By Daniel Ferguson and Michael Crimmins

Daniel Ferguson, CLIMAS program manager, and Michael Crimmins, a climate science extension specialist for Arizona Cooperative Extension, visited staff members from the Hopi Department of Natural Resources (DNR) in May to discuss drought and climate change on the Colorado Plateau. During the day-and-a-half Ferguson and Crimmins were able to spend with the Hopi DNR, one theme continually emerged: who's monitoring the current drought on the Colorado Plateau?

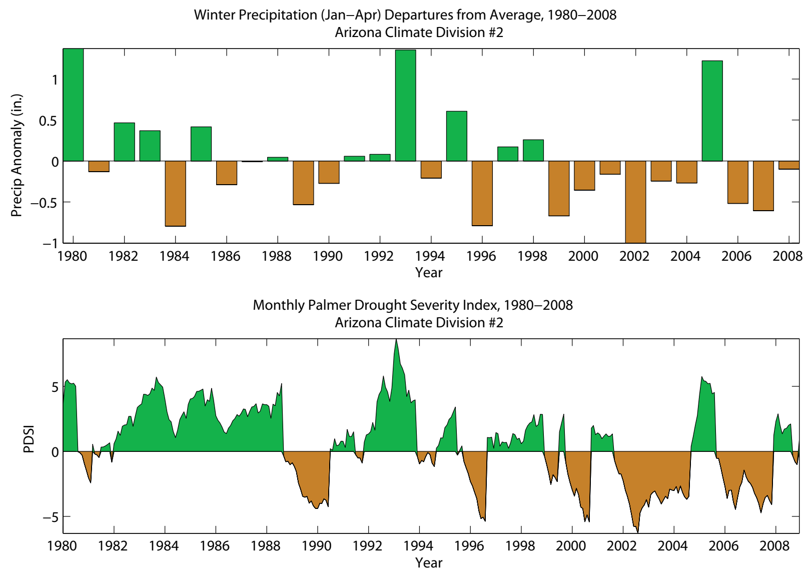

Figure 1. Precipitation and Palmer Drought Severity Index data from Arizona Climate Division 2, 1980–2008.

Driving along Arizona Highway 264 toward the Hopi mesas in May 2009, our conversation kept circling back to the unusual thunderstorms that had been forming across the southern Colorado Plateau all week. These climatologically uncommon rains were a welcome relief from an otherwise dry 2009, but they certainly did not signal the end of the long-term drought plaguing the region. At the behest of Arnold Taylor, manager of the Hopi Department of Natural Resources (DNR), we were headed to Kykotsmovi, Ariz., to meet with staff members from the Hopi DNR to discuss drought and climate change on the Colorado Plateau and begin assessing the DNR's small weather monitoring network.

Prior to our visit, we were well aware that monitoring in this part of the Southwest was spotty at best, even though several federal agencies, including the National Weather Service (NWS), the US Geological Survey (USGS), and the US Department of Agriculture (USDA), and both the Hopi Nation and Navajo Nation have weather stations and stream gages across this part of the plateau. We also knew the ongoing drought was creating a variety of impacts, but our day-and-a-half visit with our Hopi colleagues made clear that natural resource managers and climate scientists alike were all facing the same fundamental question: Is anyone actually capturing the current drought on the Colorado Plateau?

Mr. Taylor had invited us to the Hopi Nation to brief his staff about current science, but perhaps more important, he wanted to make us aware of drought conditions on the reservation and Hopi efforts to monitor it.

The string of very dry years has Mr. Taylor concerned about present conditions as well as anticipated changes in climate that are expected to bring even more intense droughts. In the midst of this current drought, it is clear the somewhat ad hoc climate monitoring network across the region is having difficulties resolving and tracking these conditions.

Hopi people have been living on or near the mesas at the heart of the current Hopi reservation for more than a millennium. Located on the Colorado Plateau, in the Little Colorado River watershed, the Hopi landscape encompasses high mesas, deep canyons, and an arid climate. As dryland farmers and ranchers, the Hopi have a long and deep cultural relationship with the climate of the Southwest. Drought is neither uncommon nor unexpected in Hopiland, but current drought conditions and recent science about a future warmer, dryer Southwest has decision makers across the desert Southwest, including Hopi resource managers like Mr. Taylor, asking a common question: how do we best proceed into a climatologically uncertain future?

One clear component of any answer to this question is effective monitoring of weather, climate, and drought impacts. Our Hopi hosts made clear throughout our visit that monitoring on the Hopi Nation and across the Colorado Plateau is inadequate for the climate adaptation task at hand. Recent work led by CLIMAS investigator Dr. Gregg Garfin and a team of researchers from The University of Arizona, Arizona State University, and Northern Arizona University, in partnership with the Navajo Nation, resulted in a detailed assessment of monitoring issues on the Navajo Nation

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that also indicated a large climate monitoring gap on the Colorado Plateau.

Drought on the southern Colorado Plateau: 15 years and counting

Both the Hopi Nation and Navajo Nation in northern Arizona have quietly been suffering through drought conditions for well over a decade. A quick look at coarse precipitation data for the northeastern quarter of Arizona (Climate division 2, covering all of Coconino, Apache, and Navajo counties) shows that winter precipitation from January through April has been below average 11 out of the last 15 years since 1994 (Figure 1). The years 1996 and 2002 stand out as exceptionally dry, with most of the other years just below the long-term average for winter precipitation. A plot of monthly Palmer Drought Severity Index (PDSI) values over the same period shows a clearer picture of the cumulative effect of the somewhat subtle string of below-average winters (Figure 1). A shift from very wet conditions in the winter of 1993 to very dry in 1994 marked what several Hopi natural resource managers that we met consider the beginning of the current long-term drought. Below-average precipitation has kept PDSI values negative (indicating dry conditions) in a majority of months up through the present.

An unusually wet winter spanning December 2004 through February 2005 brought widespread, heavy snow to northern Arizona and temporary drought relief. Above-average temperatures and below-average precipitation later that spring quickly melted snow and brought back short-term drought conditions, as depicted in the deep drop in PDSI values (see Figure 1).

These climate data only hint at the actual drought conditions experienced on the ground by the Hopi and Navajo people. Resource managers on the Hopi Nation report wide-ranging drought impacts to rangeland and water resources, including poor forage quality and dry stock tanks.

Figure 2. Rangeland across the Hopi Nation and Navajo Nation was heavily impacted by severe dust storms in April. Range conditions, already stressed by overgrazing and years of persistent drought, have been degrading rapidly in recent years.

During our visit to Kykotsmovi, we were presented with photographs and range reports related to extreme dust storms in April 2009. These storms buried rangelands on parts of the Hopi Nation as high winds moved loose soil from dunes and already degraded rangelands. Several inches of dust smothered vegetation across the plateau, leading to further impacts on range conditions. Such wind-driven sandstorms have plagued the Hopi Nation and Navajo Nation in recent years. Indeed, research by U.S. Geological Survey (USGS) scientist Dr. Margaret Hiza-Redsteer has indicated recent drought conditions have supported a large increase in wind erosion and sand dune mobility across northeastern Arizona. In addition, as reported in the June 2008 issue of *High Country News*, Dr. Hiza Redsteer and University of Arizona Ph.D. candidate Casey Thornbrugh observed that higher spring temperatures in recent years have negatively impacted rangeland vegetation, leading to more wind erosion and movement of sand dunes.

The sensitivity of this landscape to complex interactions between temperature and precipitation variability and its ominous slide toward desertification argue for more responsive and place-based drought monitoring strategies. These could include a combination of volunteer climate observations, new remote sensing-based tools, and investment in new, high-quality official monitoring stations tied to national networks (e.g., NOAA Climate Reference Network).

Compounding dust storms and desertification, warming temperatures and the invasion of new weed species hamper the recovery of rangelands when more favorable rains return. In addition, in an area where livestock production is an important industry, the invasive weeds are changing the composition of existing forage; many of the encroaching species are of limited palatability or are even toxic to livestock, reinforcing the stress on ranching operations. During our visit, Priscilla Pavatea, director of the Hopi Range Management Office, reported the total number of cattle on Hopi lands has fallen 60 percent since 1994 due to decreasing forage production and quality.

A challenging geography for drought monitoring

These drought impacts are particularly surprising if you look at a current map of long-term precipitation deficits for

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Who's paying attention, continued

the region or even the current National Drought Monitor (see page 8). Precipitation totals have been slightly below-average over the past couple of years, but have not signaled a deep and persistent drought. Why is it that current drought monitoring programs at state and national levels seem to be overlooking this drought situation on the Hopi Nation and Navajo Nation?

Part of the problem is explained by examining how precipitation and temperature data, key variables in tracking drought conditions, are collected across this region. The recent work by Dr. Garfin and his colleagues to assess hydroclimatic monitoring needs for the Navajo Nation found only 20 active National Weather Service Cooperative Observer (NWS-COOP) sites collecting temperature and precipitation data across the Navajo and Hopi reservations. The land area of the two reservations covers nearly 30,000 square miles, roughly the size of South Carolina, which has more than 100 NWS-COOP sites.

The 20 NWS-COOP sites on the reservations are distributed relatively well across the Navajo and Hopi lands but cannot even begin to adequately characterize the complex climatic patterns across the region. Only a subset of them have reports timely enough to be integrated into weekly and monthly climate maps used by state and national drought monitoring officials.

Elevations vary from over 2,500 meters in the Chuska Mountains to less than 1,200 meters along the banks of the Colorado River, so the region is home to dramatically varying mean precipitation amounts and vegetation communities that range from conifer forest to desert scrub.

The characteristics of the precipitation that falls across this region also creates a challenging environment for climate and drought monitoring. Winter storms typically bring widespread light- to moderate-intensity rain and snow, providing relative uniform coverage that can support the recharge of soil moisture and local water resources. Summer thunderstorms, on the other hand, can be very isolated, dropping large amounts of rain over small areas. This can create a patchwork of drought impacts during the summer that reflects where precipitation has or has not fallen. Only very dense rain gage networks—which the reservations lack—can capture the capricious patterns of precipitation during the summer in northern Arizona.

Furthermore, traditional precipitation-based drought metrics have missed some subtle but important interactions with other climate variables, adding to the drought monitoring hurdles in the region. Increasing temperatures over the period have been implicated in exacerbating some of the observed drought impacts by creating additional moisture stress on vegetation.

Monitoring drought and climate for the 21st century on the Colorado Plateau

On the morning of the second day of our visit to Kykotsmovi, we had the opportunity to visit two of the Hopi Water Resources Program's (WRP) weather monitoring stations with Jon Mason, the WRP Non-point Source Coordinator, and Shirley Piqosa and Avery Pavinyama, both WRP technicians.

Through the WRP, the Hopi DNR is able to gather some weather data across a handful of sites on the Hopi Nation. The small network the program is able to maintain, however, is insufficient for truly monitoring climate or drought, a fact that is abundantly clear to Mr. Taylor and the DNR staff. With extremely limited resources, the Hopi DNR, like many other natural resource management agencies throughout the region, is unable to gather enough quality data or analyze what they can collect in such a way that it is useful for decision making.

With a potential long-term drought already underway, and a strong signal that the whole Southwest is warming, it seemed clear to all of us during our visit that it is going to take a sustained effort and a number of partnerships to begin addressing the monitoring gap that exists on the Colorado Plateau.

Our visit to Kykotsmovi presented us with a question: who is monitoring drought and climate on tribal nations on the Colorado Plateau? The answer, it turns out, is many of us in the climate science and natural resource management communities are monitoring the situation, but in an incoherent and uncoordinated way that does little to support management decisions across the region. With an ad hoc network of instruments from the Hopi Nation and Navajo Nation, the National Weather Service, the USGS, and a variety of other entities, a steady stream of information exists but much of it is ill-suited for answering fundamental questions about adapting to climate.

One obvious path forward is working toward better coordination and cooperation among the many stakeholders in the region. The Hopi and Navajo reservations represent a significant portion of the Colorado Plateau and Colorado River watershed. Given the scale of this area, tribal, federal, and state land and water resource managers all have an interest in better climate monitoring across the region. Neither the tribes themselves, nor any one agency, is well positioned to solely support monitoring and data analysis activities on the Plateau.

Short-term resource management decision making and long-term climate change adaptation planning both require a high-quality regional climate monitoring network. Building creative partnerships and working together to find resources and coordinate efforts currently offers the best hope of improving our collective understanding of what is happening now across the region and how to prepare for anticipated changes in climate in the future.

Temperature (through 7/15/09)

Source: High Plains Regional Climate Center

Average temperatures in the Southwest since the water year began October 1 have been highest in the southwest deserts of Arizona, ranging between 65 and 75 degrees Fahrenheit (Figure 1a). Average temperatures have been lowest in the mountains of northern New Mexico and north central Arizona, where they range between 35 to 45 degrees F. In northern New Mexico and Arizona temperatures have ranged between 45 and 55 degrees F, while the southern deserts of New Mexico have been between 55 and 65 degrees F. Much of both states have seen temperatures that are 1–3 degrees above average (Figure 1b). However, several isolated high elevation areas have been a degree or so below average. Also, around Bagdad, Ariz., average temperatures are approximately 3 degrees below average due to a station relocation rather than a drop in temperatures; recent temperatures, however, have been similar to surrounding communities.

Over the past 30 days, temperatures have been 0 to 4 degrees above average across most of Arizona and New Mexico (Figures 1c–d). Although there has been rain in Arizona and New Mexico every day since mid-June, days have been mostly clear and nights have been mostly cloudy, which has led to high temperatures. Only a few areas in western New Mexico and southern Arizona have had below-average temperatures. With the movement northeast of the monsoon, triple digit temperatures will return to western and central Arizona.

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 '08–'09 (through July 15, 2009) average temperature.

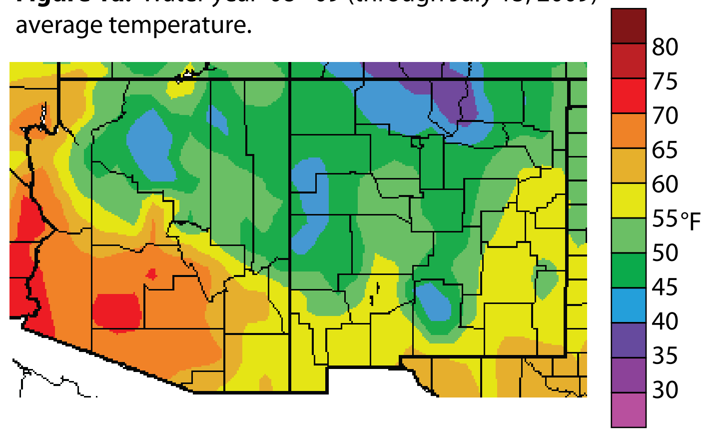


Figure 1b. Water year '08–'09 (through July 15, 2009) departure from average temperature.

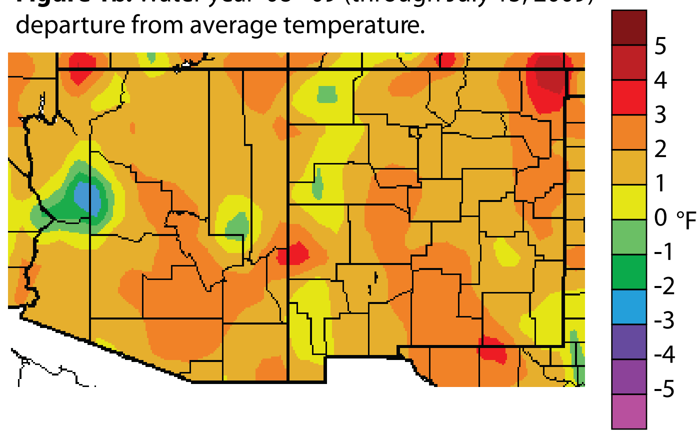


Figure 1c. Previous 30 days (June 16–July 15, 2009) departure from average temperature (interpolated).

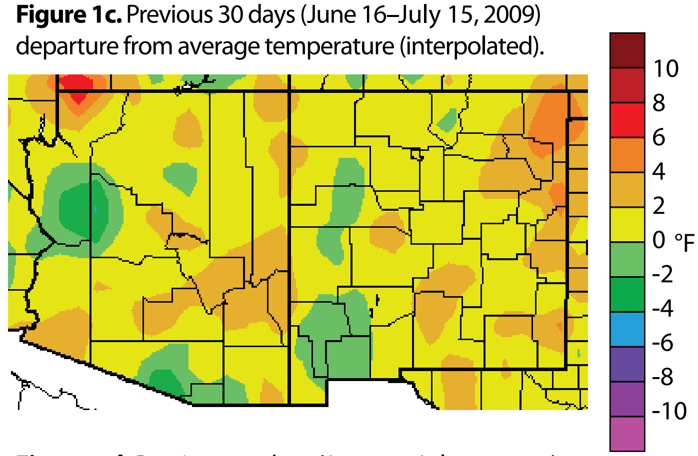
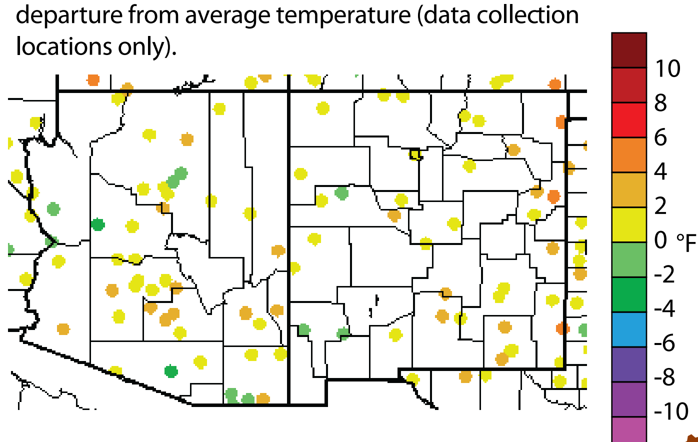


Figure 1d. Previous 30 days (June 16–July 15, 2009) departure from average temperature (data collection locations only).



Precipitation (through 7/15/09)

Source: High Plains Regional Climate Center

Precipitation since the water year began October 1 has been between 25 and 90 percent of average across nearly all of Arizona and New Mexico (Figures 2a–b). The Sangre de Cristo Mountains in north-central New Mexico, the White Mountains on the Arizona and New Mexico border, and the Canyon de Chelly area on the Navajo Nation have received 110–130 percent of average precipitation. The spotty rain pattern reflects the weak precipitation this past winter characterized by isolated storms that moved quickly across the region. Normally, winter storms are fairly uniform across the northern and central parts of the two states. The pattern also was impacted by late spring and early summer storms that have been scattered and isolated.

The past 30 days have been much wetter than average in south-central and east-central Arizona and central and southeastern New Mexico as a result of monsoon activity (Figures 2c–d). The northwestern half of Arizona and the northwest, northeast, and southwest corners of New Mexico have received between 0 and 70 percent of average precipitation. The monsoon forecast, calling for an early and wet beginning, has come true in some areas, but others remain much drier than expected. So far the monsoon moisture flow has been toward the northeast, leaving northern and western Arizona very dry.

Notes:

The water year begins on October 1 and ends on September 30 of the following year. As of October 1, 2008, we are in the 2009 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 '08–'09 (through July 15, 2009) percent of average precipitation (interpolated).

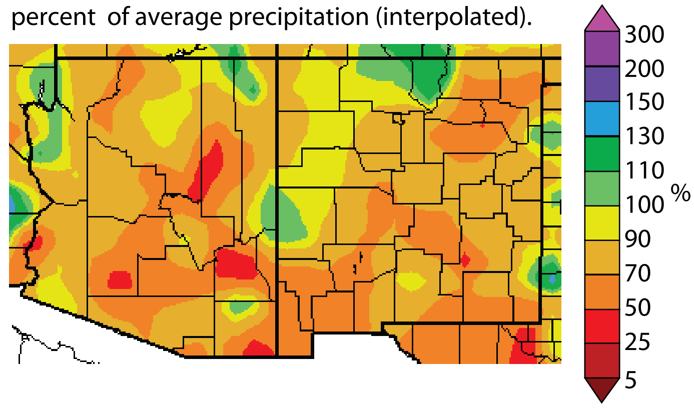


Figure 2b. Water year '08–'09 (through July 15, 2009) percent of average precipitation (data collection locations only).

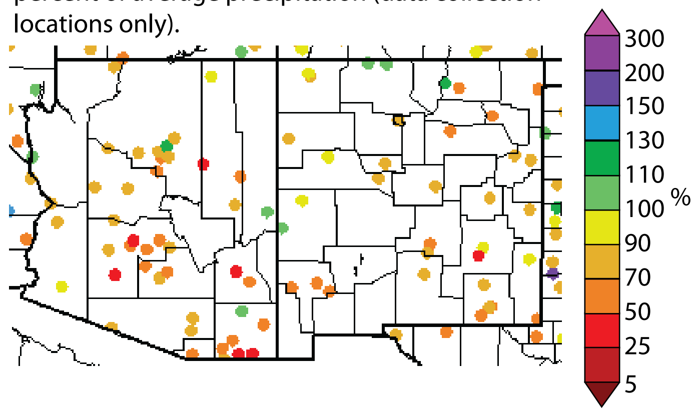


Figure 2c. Previous 30 days (June 16–July 15, 2009) percent of average precipitation (interpolated).

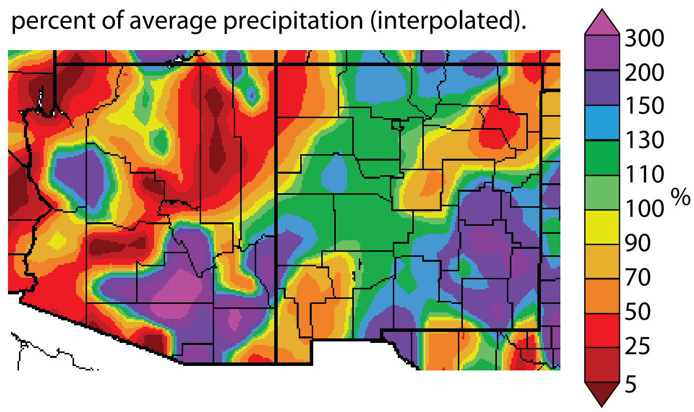
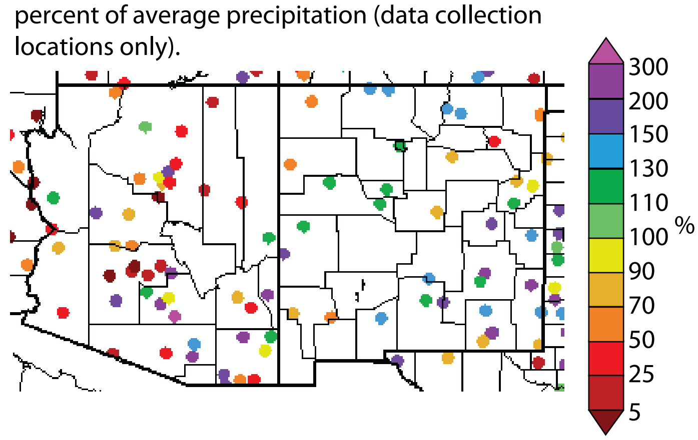


Figure 2d. Previous 30 days (June 16–July 15, 2009) percent of average precipitation (data collection locations only).



U.S. Drought Monitor

(released 7/16/09)

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

Monsoon rains have provided some relief and helped improve short-term drought conditions across much of the Southwest (Figure 3). The National Drought Monitor shows the extent of moderate to severe agricultural drought has decreased across New Mexico due to recent precipitation but these conditions still persist across the eastern third of the state. Moderate drought has retreated from southeast Arizona since last month, leaving about half of the state with abnormally dry conditions. Extreme to exceptional drought conditions continue to expand across southern Texas, where exceptionally dry conditions have persisted for many months. Portions of southern Texas have observed less than 25 percent of average precipitation since last fall.

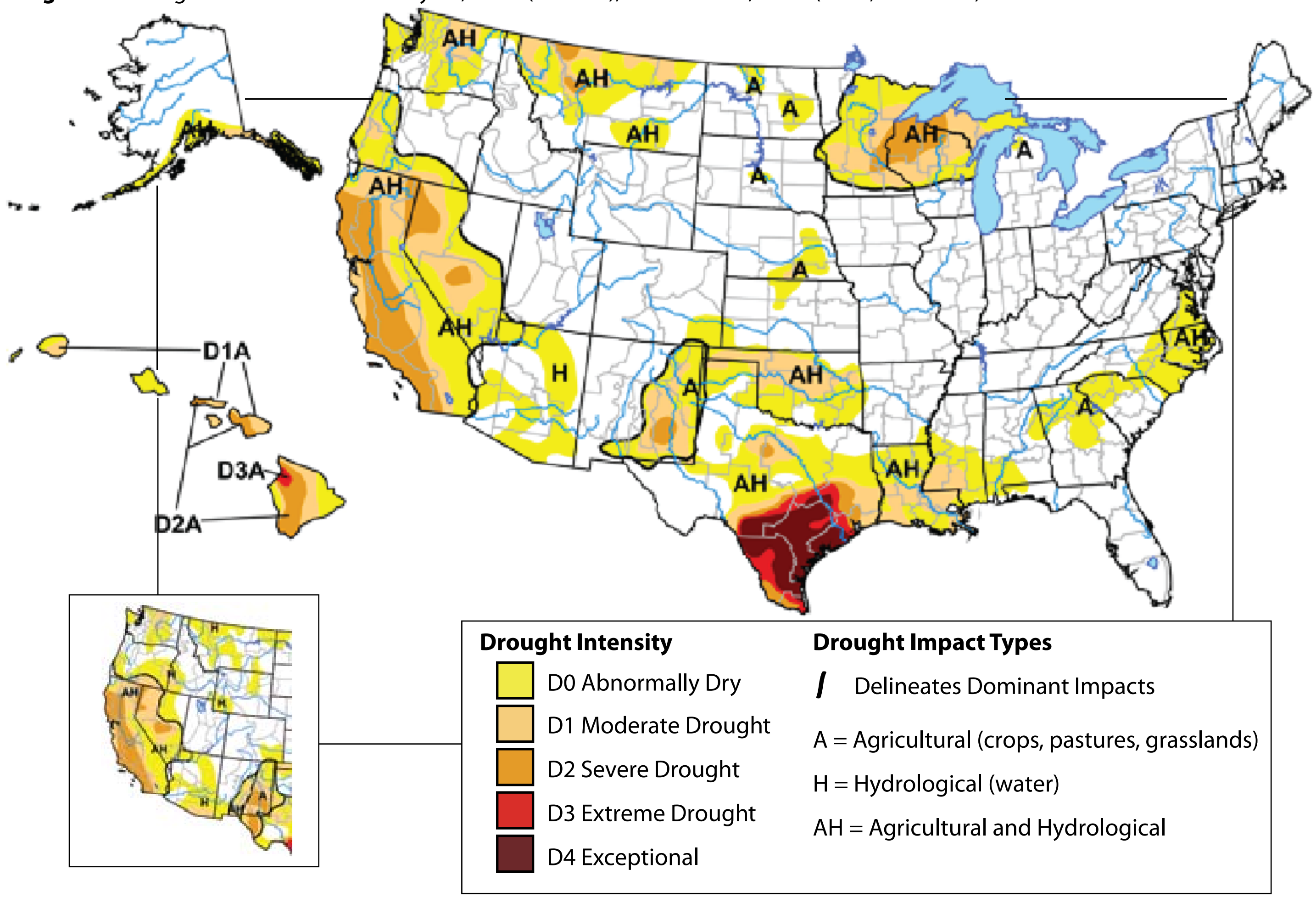
Agriculture officials in Texas expect drought-related losses to ranchers to exceed $1 billion (*USA Today*, March 13). By mid-March, Texas cattle ranchers had lost $829 million since last summer, spending substantial money on hay and supplemental feed and the cost of trucking in additional hay. The drought losses also include failed wheat crops usually used for grazing. Drought conditions are expected to continue across the region through the fall, increasing the economic toll for ranchers.

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 Eric Luebehusen, US. Department of Agriculture.

Figure 3. Drought Monitor released July 16, 2009 (full size), and June 18, 2009 (inset, lower left).



On the Web:

The best way to monitor drought trends is to pay a weekly visit to the U.S. Drought Monitor website: http://www.drought.unl.edu/dm/monitor.html

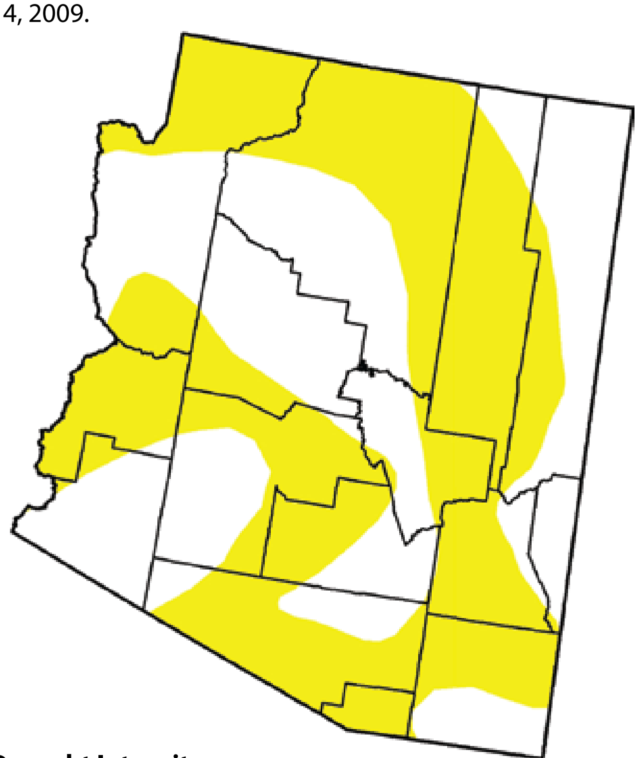
Arizona Drought Status
(released 7/16/09)

Source: U.S. Drought Monitor

The National Drought Monitor shows that drought conditions have improved across much of southeast Arizona over the past thirty days with the help of above-average precipitation since the monsoon season began June 15 (Figure 4a). Abnormally dry conditions, however, remain in this portion of the state as well as central and northern Arizona. Currently, 54 percent of Arizona is experiencing abnormally dry conditions, a decrease of nearly 10 percent from last month (Figure 4b). The state is currently not experiencing any conditions worse than abnormally dry; 7 percent of Arizona last month was deemed moderately dry.

In water news, Tucson's recently passed city ordinance requiring new commercial projects to install water harvesting devices is garnering national attention (Associated Press, July 5). The ordinance requires new commercial and corporate buildings to supply half of their water for landscaping through on site water harvesting structures that capture rainfall runoff from roofs and parking lots. Ordinances similar to Tucson's are now being developed in several other Arizona cities as well as in other states like Georgia and Colorado.

Figure 4a. Arizona drought map based on data through July 14, 2009.



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 July 14, 2009.

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	45.8	54.2	0.0	0.0	0.0	0.0
Last Week (07/07/2009 map)	45.8	54.2	0.0	0.0	0.0	0.0
3 Months Ago (04/21/2009 map)	18.7	81.3	14.4	0.0	0.0	0.0
Start of Calendar Year (01/06/2009 map)	62.3	37.7	1.0	0.0	0.0	0.0
Start of Water Year (10/07/2008 map)	83.1	16.9	0.8	0.0	0.0	0.0
One Year Ago (07/15/2008 map)	55.1	44.9	17.0	0.0	0.0	0.0

Notes:

The Arizona section of the U.S. Drought Monitor is released weekly (every Thursday) and represents data collected through the previous Tuesday. The maps are based on expert assessment of variables including (but not limited to) the Palmer Drought Severity Index, soil moisture, streamflow, precipitation, and measures of vegetation stress, as well as reports of drought impacts. It is a joint effort of several agencies.

On the Web:

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

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

New Mexico Drought Status

(released 7/16/09)

Source: New Mexico State Drought Monitoring Committee

Drought conditions continued to improve over the past 30 days across much of eastern New Mexico. The National Drought Monitor shows that moderate and severe drought conditions have decreased in geographic extent, but still cover much of the eastern third of the state (Figure 5a). Above-average precipitation from recent monsoon thunderstorm activity has provided some short-term drought relief to much of New Mexico, with the most significant improvements in the southwest counties. Currently, 44 percent of the state is observing some level of drought compared to 62 percent last month (Figure 5b). These drought conditions are markedly better than at this time last year when 81 percent of New Mexico was observing some form of drought and 45 percent of the state was classified at moderate drought levels or worse.

Even with some improvements due to recent rains, farmers and ranchers in southeastern New Mexico are struggling due to many months of moderate to severe drought conditions (KOB.com, July 10). Several counties in southeast New Mexico may be declared federal disaster areas to help provide drought assistance through the U.S. Department of Agriculture.

Figure 5a. New Mexico drought map based on data through July 14, 2009.

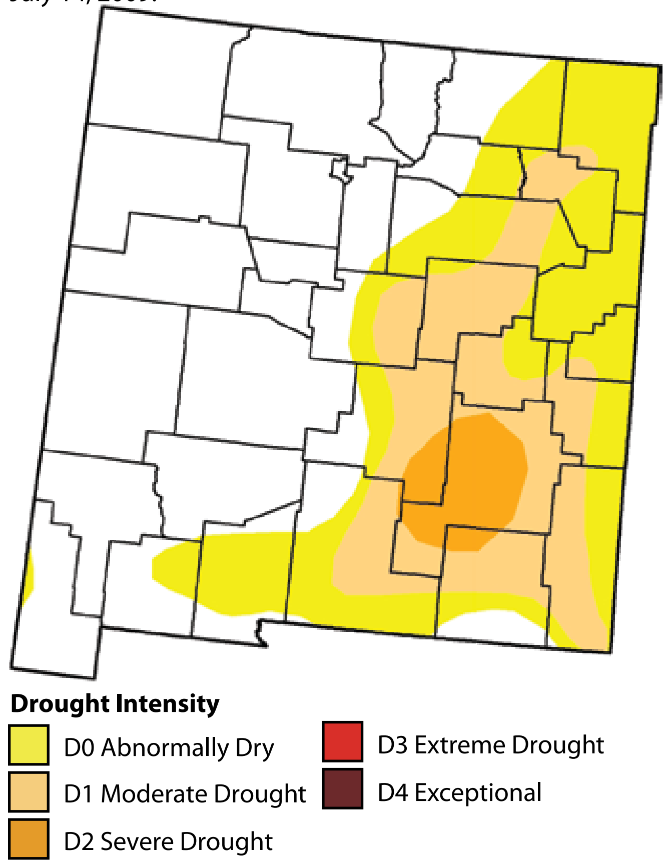


Figure 5b. Percent of New Mexico designated with drought conditions based on data through July 14, 2009.

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	56.5	43.5	20.7	3.8	0.0	0.0
Last Week (07/07/2009 map)	56.5	43.5	20.7	3.8	0.0	0.0
3 Months Ago (04/21/2009 map)	21.9	78.1	35.1	13.5	0.0	0.0
Start of Calendar Year (01/06/2009 map)	76.6	23.4	1.5	0.0	0.0	0.0
Start of Water Year (10/07/2008 map)	70.7	29.3	1.5	0.0	0.0	0.0
One Year Ago (07/15/2008 map)	18.4	81.6	45.9	17.2	1.8	0.4

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 6/30/09)

Source: NRCS, National Water and Climate Center

Water levels in Lake Powell increased by 1.3 million acre-feet during June. However, water storage in all the other large reservoirs dropped slightly this past month, andno water level data have been reported for the San Carlos and Lyman reservoirs (Figure 6). Even with the rise in water level, Lake Powell is at 66 percent of full capacity, well below the long-term average of 81 percent. Lake Mead is at 42 percent of capacity, which reflects the effects of long-term drought conditions across the Upper Colorado River Basin.

In water-related news, the Arizona Game and Fish Department received a $74,145 Water Quality Improvement grant to improve riparian habitat along the Little Colorado River in Apache County (wmicentral.com, July 17). The grant will help protect important wildlife habitat and two federally threatened and endangered species: the southwestern willow flycatcher, a small passerine bird, and the Little Colorado spinedace, a threatened native fish.

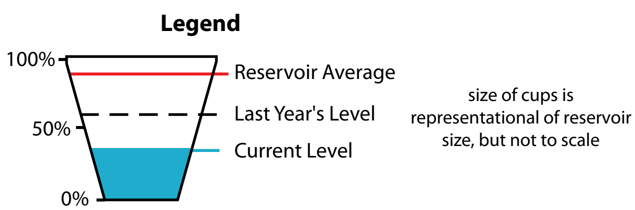
Notes:

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.

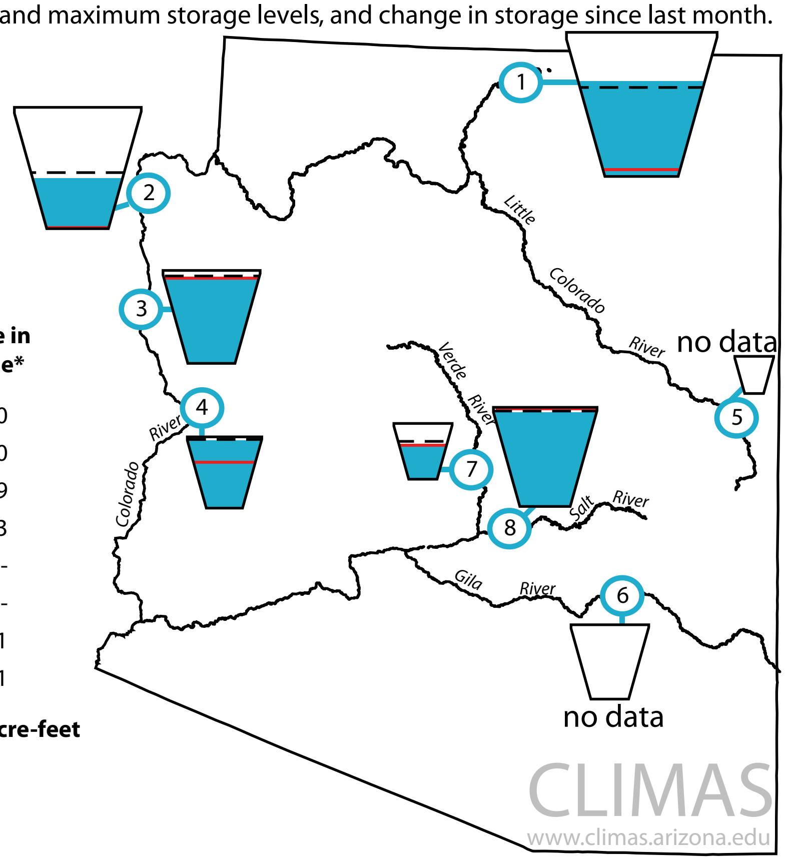
These data are based on reservoir reports updated monthly by the National Water and Climate Center of the U.S. Department of Agriculture's Natural Resource Conservation Service (NRCS). For additional information, contact Dino DeSimone, Dino.DeSimone@az.usda.gov.

Figure 6. Arizona reservoir levels for June 2009 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	66%	16,061.0	24,322.0	1310.0
2. Lake Mead	42%	11,071.0	26,159.0	-146.0
3. Lake Mohave	92%	1,669.2	1,810.0	-67.9
4. Lake Havasu	95%	589.5	619.0	-4.3
5. Lyman Reservoir	---	---	30.0	---
6. San Carlos	---	---	875.0	---
7. Verde River System	60%	173.3	287.4	-9.1
8. Salt River System	95%	1,916.1	2,025.8	-71.1

*** thousands of acre-feet**



On the Web:

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

New Mexico Reservoir Levels
(through 5/31/09)

Source: NRCS, National Water and Climate Center

Total reservoir storage in New Mexico declined by approximately 58,000 acre feet in June. Navajo Reservoir on the San Juan River and Elephant Butte Reservoir on the Rio Grande observed the largest decreases in storage—35,700 and 20,000 acre-feet, respectively (Figure 7). Last month, water levels in these reservoirs increased more than 250,000 acre feet. The largest increase in water level was at Heron Reservoir on the Rio Grande, which gained 22,700 acre-feet in the past month.

In water-related news, increased moisture from rainfall and reclaimed wastewater has helped Santa Fe and Pojoaque Pueblo reduce water use for irrigation so far this year (*Santa Fe New Mexican*, July 11). Helped by rains, the Santa Fe Canyon reservoirs (not shown on the map) are about 93 percent full, up from 87.7 percent on the same date a year earlier.

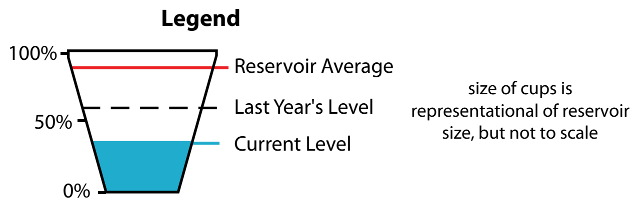
Notes:

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).

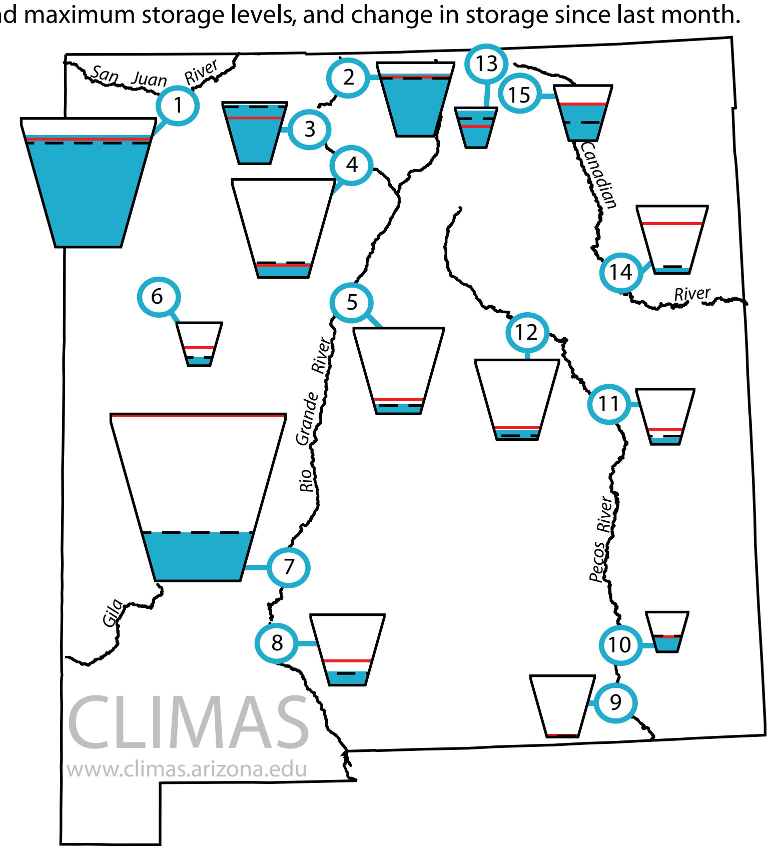
The table details more exactly the current capacity level (listed as a percent of maximum storage). Current and maximum storage levels are given in thousands of acre-feet for each reservoir. One acre-foot is the volume of water sufficient to cover an acre of land to a depth of 1 foot (approximately 325,851 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 Richard Armijo, Richard.Armijo@nm.usda.gov.

Figure 7. New Mexico reservoir levels for June 2009 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	87%	1479.4	1,696.0	-35.7
2. Heron	85%	339.4	400.0	22.7
3. El Vado	95%	180.4	190.3	1.2
4. Abiquiu	15%	177.1	1192.8	-34.2
5. Cochiti	11%	53.9	491.0	4.1
6. Bluewater	19%	7.4	38.5	0.0
7. Elephant Butte	29%	634.4	2,195.0	-20.0
8. Caballo	19%	64.6	332.0	7.7
9. Brantley	1%	11.2	1008.2	-6.7
10. Lake Avalon	38%	1.5	4.0	0.4
11. Sumner	10%	10.6	102.0	-1.5
12. Santa Rosa	12%	51.0	438.3	5.4
13. Costilla	92%	14.7	16.0	3.1
14. Conchas	8%	19.9	254.2	-2.8
15. Eagle Nest	65%	51.0	79.0	-1.2



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 Fire Summary
(updated 7/16/09)

Source: Southwest Coordination Center

Nearly 308,000 acres have burned in New Mexico and nearly 75,000 have burned in Arizona since January (Figure 8a). The Cross fire, which began June 30 from a lighting strike, is the largest current fire in the region and has scorched about 7,500 acres of the Kaibab National Forest south of Williams, Ariz. The fire has been burning through the forest understory and debris, helping promote forest health and prevent future forest fires that would be more destructive, according to the Williams Ranger district. Many of the current fires burning more than 100 acres in Arizona are around the Mogollon Rim, where June precipitation was below average. Most of these fires and those in New Mexico were caused by lightning.

Both Arizona and New Mexico are experiencing below-average fire activity this year (Figures 8b–c). Contributing to this was nearly twice the amount of precipitation than average in June for eastern Arizona and western New Mexico. However, recently observed national fire danger ratings denote moderate to high fire danger across most of Arizona and New Mexico, except for the Four Corners region in northwestern Arizona and along the California-Arizona border from Lake Havasu City to Yuma. In these regions, danger ratings range from very high to extreme. According to the National Interagency Fire Center, the 100-hour fuel moisture index, which represents the moisture content of dead fuels of one- to three-inches in diameter, is less than 10 percent in most of New Mexico and Arizona. This suggests that these areas are prime for fire; monsoon rains, however, can rapidly moisten the landscape.

Figure 8a. Year-to-date wildland fire information for Arizona and New Mexico as of July 6, 2009.

State	Human Caused Fires	Human caused acres	Lightning caused fires	Lightning caused acres	Total Fires	Total Acres
AZ	825	65,734	158	9,051	983	74,785
NM	515	88,181	215	219,465	730	307,646
Total	1340	153,915	3732	228,516	1713	382,431

Figure 8b. Arizona large fire incidents as of July 16, 2009.

Figure 8c. New Mexico large fire incidents as of July 16, 2009.

Notes:

The fires discussed here have been reported by federal, state, or tribal agencies during 2009. The figures include information both for current fires and for fires that have been suppressed. The top figure shows a table of year-to-date fire information for Arizona and New Mexico. Prescribed burns are not included in these numbers. The bottom two figures indicate the approximate locations of past and present "large" wildland fires and prescribed burns in Arizona and in New Mexico. A "large" fire is defined as a blaze covering 100 acres or more in timber or 300 acres or more in grass or brush. The name of each fire is provided next to the symbol.

On the Web:

These data are obtained from the Southwest Coordination Center website:

http://gacc.nifc.gov/swcc/predictive/intelligence/daily/ytd_wf_daily_state.pdf

http://gacc.nifc.gov/swcc/predictive/intelligence/maps/wf/swa_fire_combined.htm

Monsoon Summary
(through 7/14/2009)

Source: Western Regional Climate Center

The 2009 monsoon forecast, which called for an early start to the rains and above-normal precipitation for the first half of the season, appears to have been correct. According to meteorological criteria such as the direction of winds, the monsoon began in mid-June for Arizona and New Mexico. The average start date in Tucson during the last 60 years is July 3, while the average monsoon onset in Phoenix is July 7.

Since June 15, southern Arizona, southeast New Mexico, and parts of central and northern New Mexico have received above-normal precipitation (Figures 9a–c). The Four Corners region, however, has been dry, but it's still too early to judge this area because rains often begin in earnest there in late July. While the dryness in the northern areas is not out of the ordinary, it is unusual for Arizona's Mogollon Rim country to be as dry as it is currently. Hot and dry weather in south Texas has stalled the high pressure system south of its typical location over the Four Corners region. The high is expected to migrate north in the coming weeks, increasing the chances for significant rainfall in the Southwest, according to the National Weather Service.

Figure 9a. Total precipitation in inches (June 15–July 14, 2009).

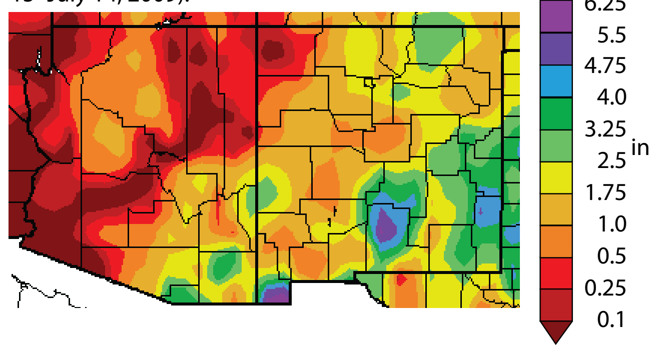


Figure 9b. Departure from average precipitation in inches (June 15–July 14, 2009).

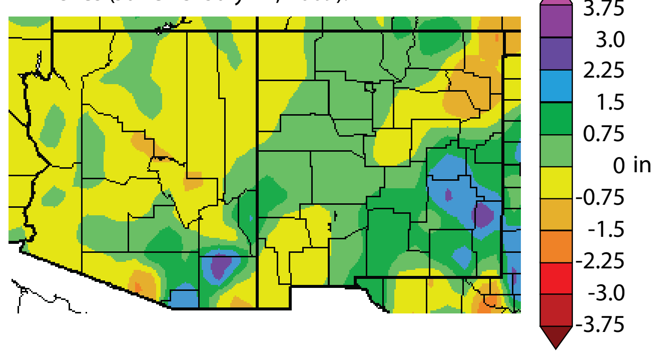
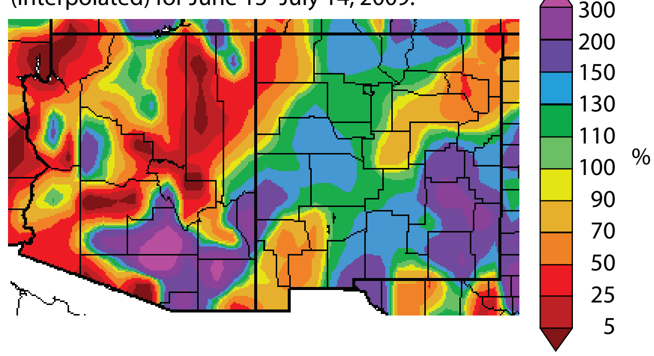


Figure 9c. Percent of average precipitation (interpolated) for June 15–July 14, 2009.



Notes:

The continuous color maps (figures above) 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.

On the Web:

These data are obtained from the National Climatic Data Center:
http://www.hprcc.unl.edu/maps/current/

Temperature Outlook

(August 2009–January 2010)

Source: NOAA-Climate Prediction Center (CPC)

The NOAA-Climate Prediction Center (NOAA–CPC) long-lead temperature forecasts for the continental U.S. show increased chances of warmer-than-average summer and fall temperatures. The temperature forecast for August through October shows increased chances for temperatures similar to those of the warmest 10 years of the 1971–2000 observed record for most of the southern tier of the US (Figure 10a). As the forecast proceeds through the fall, chances stay high that the Southwest will experience warmer-than-average temperatures (Figures 10b–d). These temperature forecasts are based on ongoing warming temperature trends as well as El Niño-Southern Oscillation (ENSO) conditions. ENSO conditions are now classified as El Niño, which typically results in cooler fall and winter conditions through the Southwest.

Notes:

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

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

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

Equal Chances (EC) indicates areas where no forecast skill has been demonstrated or there is no clear climate signal; areas labeled EC suggest an equal likelihood of above-average, average, and below-average conditions, as a "default option" when forecast skill is poor.

Figure 10a. Long-lead national temperature forecast for August–October 2009.

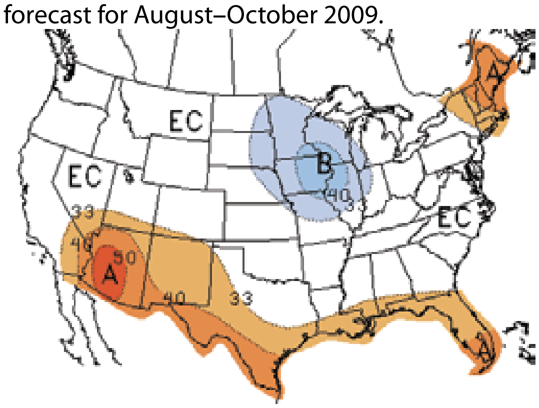
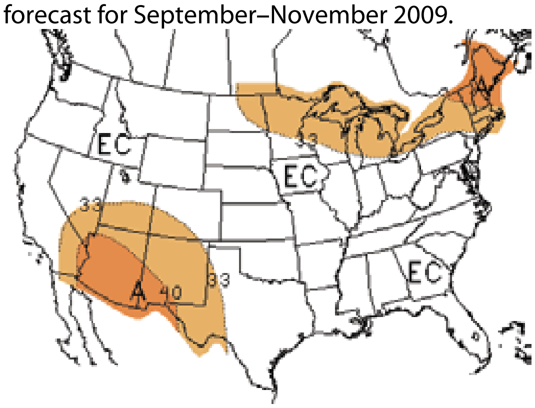


Figure 10b. Long-lead national temperature forecast for September–November 2009.



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

B=Below
40.0–49.9%
33.3–39.9%

Figure 10c. Long-lead national temperature forecast for October–December 2009.

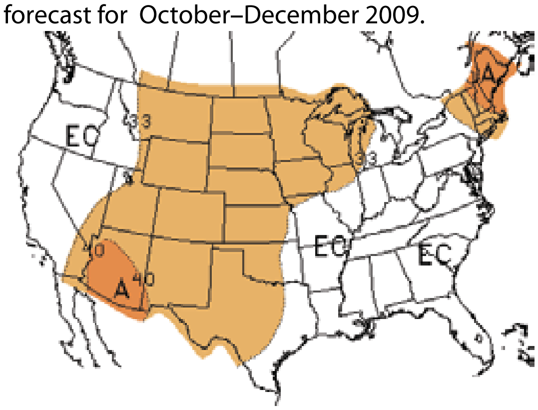
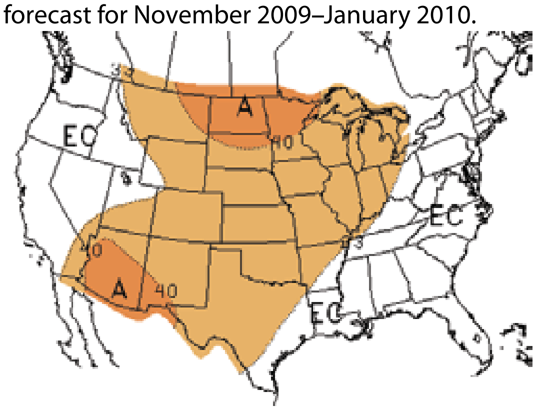


Figure 10d. Long-lead national temperature forecast for November 2009–January 2010.



EC= Equal chances. No forecasted anomalies.

On the Web:

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

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

Precipitation Outlook
(August 2009–January 2010)

Source: NOAA-Climate Prediction Center (CPC)

The NOAA-Climate Prediction Center (NOAA–CPC) long-lead precipitation forecasts through December show mostly equal chances of below-, above-, or near-average conditions (Figures 11a–c). Forecasters are uncertain because El Niño events are often associated with two phenomena that have opposite effects on precipitation in the Southwest: while they often stifle summer rains by weakening and/or repositioning the subtropical high that guides moisture into the Southwest, they also increase the number of tropical storms, some of which deliver copious rains to the Southwest.

The forecast for November 2009–January 2010 shows a shift in the odds for much of southern Arizona and southern New Mexico toward precipitation conditions like those of the wettest 10 years of 1971–2000 observed record (Figure 11d). This forecast is partly related to El Niño events, which typically bring wetter winter conditions.

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 11a. Long-lead national precipitation forecast for August–October 2009.

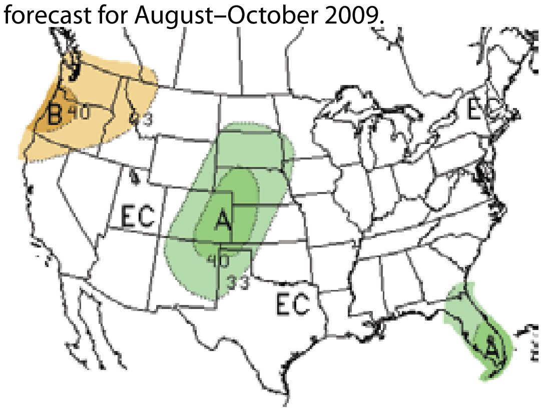


Figure 11b. Long-lead national precipitation forecast for September–November 2009.

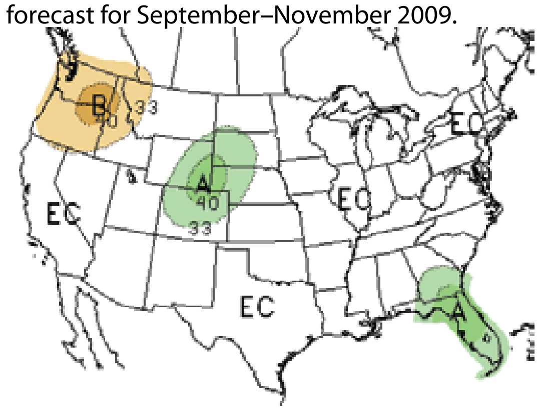


Figure 11c. Long-lead national precipitation forecast for October–December 2009.

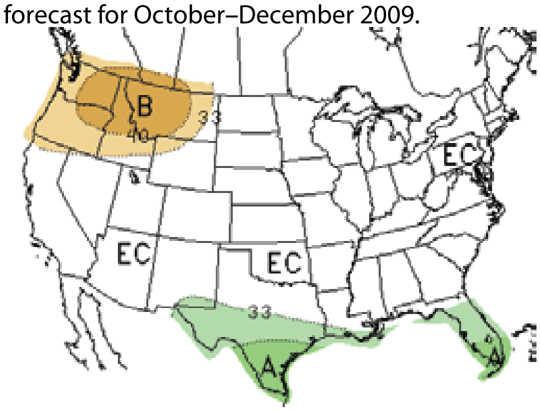
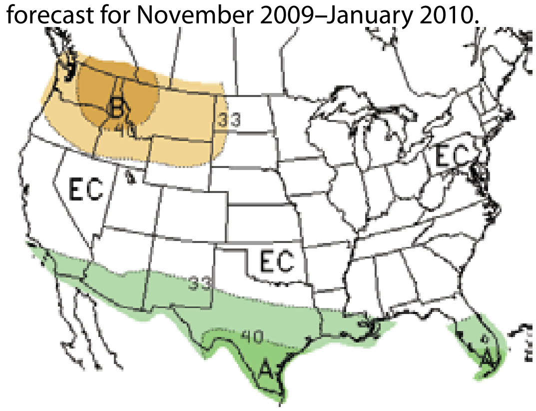


Figure 11d. Long-lead national precipitation forecast for November 2009–January 2010.



B= Below: 33.3–39.9%, 40.0–49.9%

A=Above: 40.0–49.9%, 33.3–39.9%

EC= Equal chances. No forecasted anomalies.

On the Web:

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

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

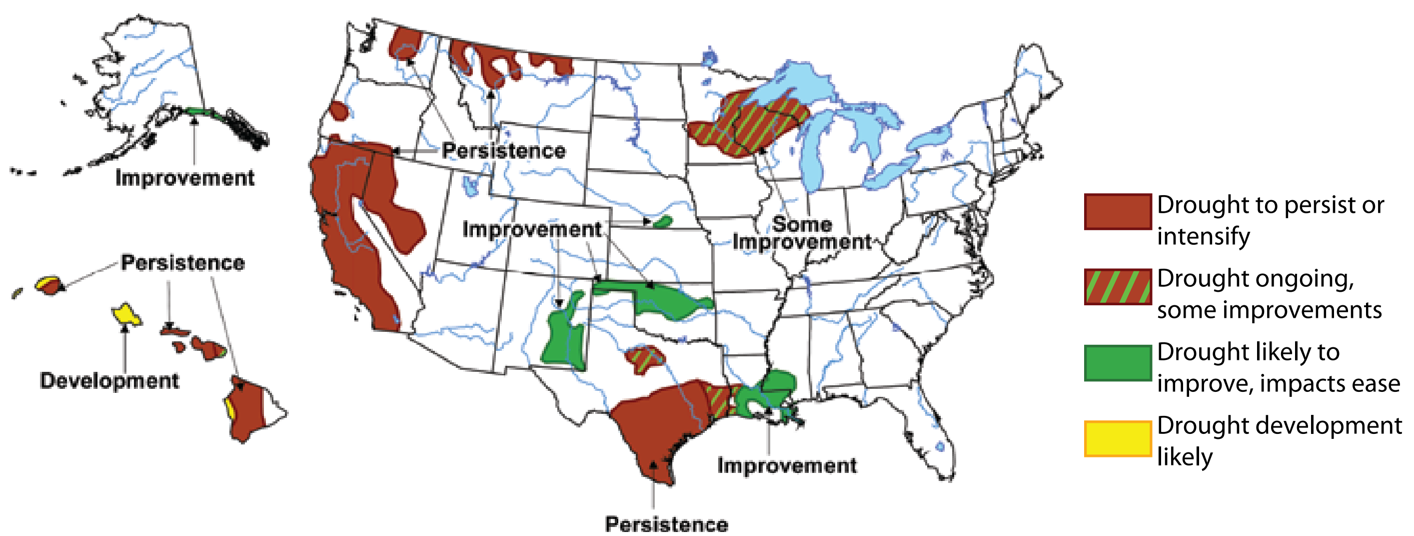
Seasonal Drought Outlook
(through October 2009)
Source: NOAA-Climate Prediction Center (CPC)

The latest Seasonal Drought Outlook issued by NOAA-Climate Prediction Center (CPC) states that drought recently was eliminated in Arizona and has been reduced in New Mexico. Monsoon rains, which are often strongest during August in New Mexico, have contributed to the CPC August–October precipitation outlook, which calls for enhanced odds for above-median precipitation across the ongoing drought area in New Mexico (Figure 12). As a result, improvement in drought conditions is forecast across eastern New Mexico, and the forecast confidence is high.

Elsewhere, hot temperatures combined with below-average rainfall have resulted in drought expansion across the western Gulf of Mexico region, while an exceptional drought continues in south Texas and is expected to persist there. It should be noted that the arrival of El Niño could bring relief to the Texas drought later in the fall and winter. Improvement also is forecast for drought areas across southern Nebraska and Oklahoma, where much-needed rainfall and cooler temperatures are expected during the remainder of July, and some improvement is forecast across the upper Midwest. Although not depicted on the map, eastern Ohio should be closely monitored for drought development. Drought is forecast to persist across California, Nevada, interior Washington, and Montana.

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 12. Seasonal drought outlook through October 2009 (released July 16, 2009).



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

Wildland Fire Outlook
(August–October 2009)
Sources: National Interagency Coordination Center, Southwest Coordination Center

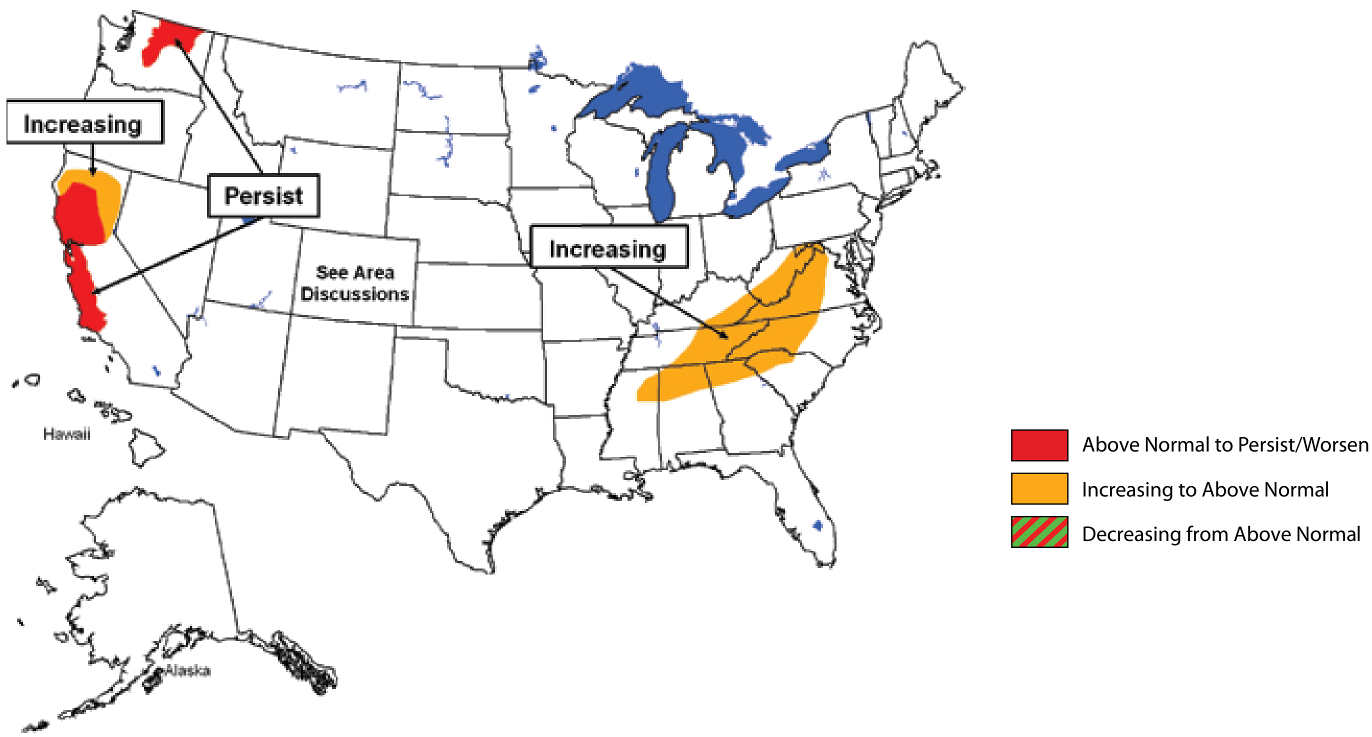
The Southwest Coordination Center reports that vegetation growth from recent precipitation in many parts of the Southwest will help inhibit fire potential for the remainder of July despite the expectation of warmer weather conditions. Periodic moisture surges from the Gulf of California and northern cold fronts will continue to bring precipitation across central portions of the Southwest through much of July.

The Southwest Coordination Center's outlook for August–October indicates below-normal fire activity for southeastern Arizona and the western two-thirds of New Mexico due to continued monsoon thunderstorms in the region (Figure 13). Despite the forecast for above-normal temperatures, the expectation of enhanced precipitation over portions of the Southwest helps reduce fire threat. However, normal fire activity is expected in western Arizona, the Four Corners area, and eastern New Mexico due to intermittent windy and dry conditions that may occur between thunderstorms.

Forecasts that contribute to the fire outlook include the Climate Prediction Center (CPC) temperature and precipitation forecasts. The CPC's summer through fall precipitation outlook indicates enhanced chances for above-average rainfall across the region, except for western Arizona. The temperature forecast shows increased chances for above-average temperatures in Arizona.

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 August–October 2009).



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

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

Scientists from the NOAA-Climate Prediction Center (NOAA-CPC) have been broadcasting the arrival of El Niño for several months. On July 9, they made it official. NOAA-CPC expects this El Niño event to continue developing during the next several months. Current conditions favor a weak to moderate event that lasts through the 2009–2010 winter. During the last month, sea surface temperature (SST) anomalies continued to increase, with the warmest temperatures exceeding 1.6 degrees Fahrenheit above average, or 1 degree Celsius. The Southern Oscillation Index (SOI), a measure of the air pressure fluctuations in the equatorial Pacific Ocean, increased slightly this month from -0.4 to -0.3 (Figure 14a). Climate models suggest an 82 percent chance that El Niño conditions will continue into the July–September season and only a 17 percent likelihood that the El Niño will dissipate into ENSO-neutral conditions, according to the International Research Institute for Climate and Society (IRI) (Figure 14b). The IRI states probabilities for La Niña conditions remain below 10 percent until the middle of spring 2010.

The arrival of El Niño conditions likely will affect precipitation in the Southwest. El Niño events usually enhance winter rain and snow, and fall rains can be copious and intense if tropical storms, which form in greater numbers during an El Niño, blow into the region. The monsoon storms also will also be affected, but it is unclear how. El Niño events often stifle summer rains in the Southwest because they weaken and/or reposition the subtropical high that guides moisture into the Southwest. But an El Niño also can increase tropical storms in the Pacific Ocean, which sometimes bring heavy rains to the region. NOAA-CPC forecasters are uncertain which phenomena will win out.

Notes:

Figure 14a shows the standardized three month running average values of the Southern Oscillation Index (SOI) from January 1980 through March 2009. The SOI measures the atmospheric response to SST changes across the Pacific Ocean Basin. The SOI is strongly associated with climate effects in the Southwest. Values greater than 0.5 represent La Niña conditions, which are frequently associated with dry winters and sometimes with wet summers. Values less than -0.5 represent El Niño conditions, which are often associated with wet winters.

Figure 14b 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–June 2009. 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).

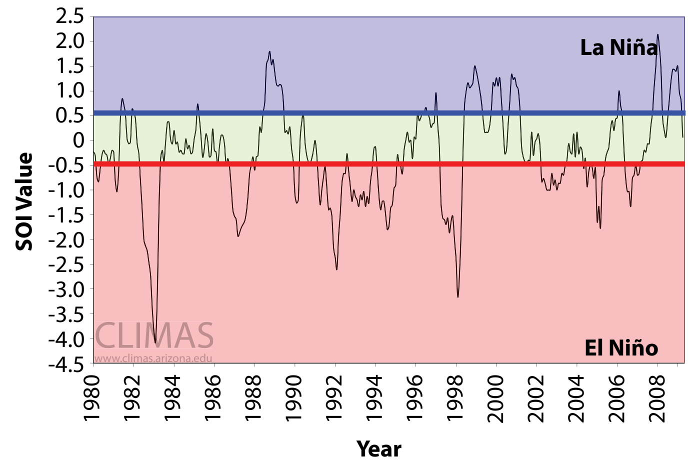
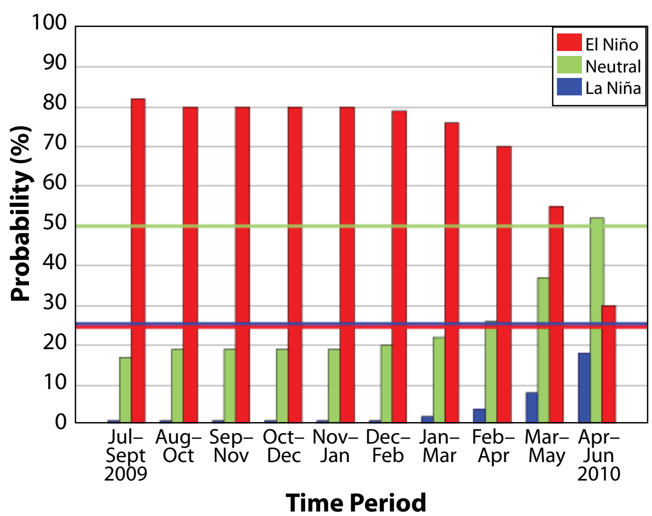


Figure 14b. IRI probabilistic ENSO forecast for El Niño 3.4 monitoring region (released July 16, 2009). Colored lines represent average historical probability of El Niño, La Niña, and neutral.



Temperature Verification

(August 2009–January 2010)

Source: Forecast Evaluation Tool

CLIMAS seeks feedback on these new highlights. Please email zguido@email.arizona.edu or call 520-882-0870.

The NOAA-Climate Prediction Center (CPC) forecasts show increased chances for temperatures in the Southwest to be similar to the warmest 10 years of the 1971–2000 climatological record. Comparisons of all the forecasts issued in July for the one- and two-month lead times and the actual weather suggest that these forecasts have been historically inaccurate for New Mexico (Figures 15a–b). However, these comparisons in Arizona give reason to believe the forecasts, particularly for southern and western Arizona. Comparisons of all forecasts issued for the three- and four-month lead times show a blue tint (Figures 15c–d), indicating all the forecasts issued for these lead times have been more accurate than the climatological forecasts. While stakeholders should be leery of basing decisions on forecasts with reddish colors, they can be more confident in those issued for regions with bluish 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 August–October 2009.

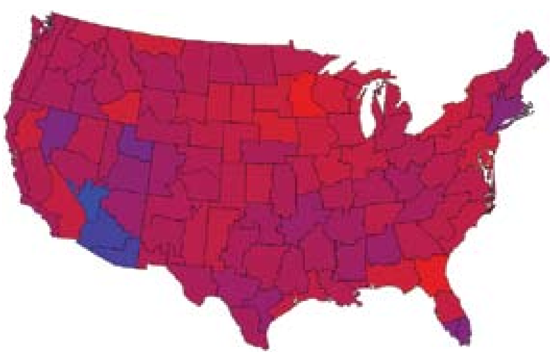


Figure 15b. RPSS for September–November 2009.

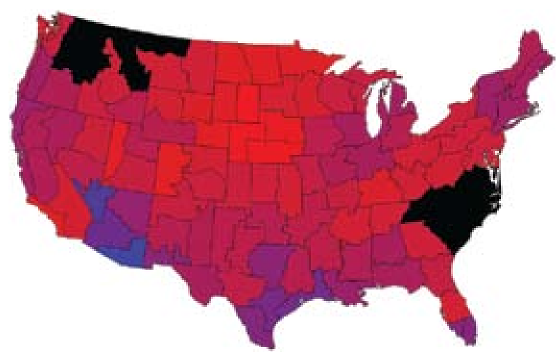


Figure 15c. RPSS for October–December 2009.

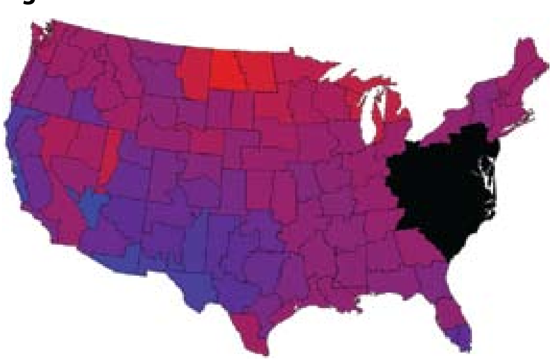
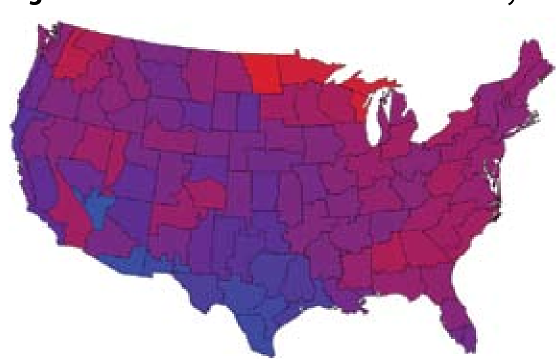


Figure 15d. RPSS for November 2009–January 2010.



■ = NO DATA (situation has not occured)

On the Web:

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

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

Precipitation Verification

(August 2009–January 2010)

Source: Forecast Evaluation Tool

CLIMAS seeks feedback on these new highlights. Please email zguido@email.arizona.edu or call 520-882-0870.

The one-month lead forecast by the NOAA-Climate Prediction Center (CPC) shows slightly increased chances for precipitation to be similar to the wettest conditions of the 1971–2000 record for northeastern New Mexico only. While the two- and three- month forecasts for the region call for equal chances, the four-month forecast suggests the southern portions of New Mexico and Arizona may be wet.

How have the NOAA-CPC forecasts for these lead times fared in the past? Comparisons of all the forecasts issued in July for the one-month lead time with the actual weather suggest the CPC forecasts in northeast New Mexico have been slightly more accurate than the climatological forecast (Figure 16a). The four-month lead time forecasts for November–January for many parts of the Southwest historically also has been slightly more accurate than the climatological forecast. The region where the forecasts have been most accurate is the southeast corner of Arizona (Figure 16d). Stakeholders should be leery of basing decisions on forecasts with reddish colors and more confident in those issued in regions with bluish colors.

Notes:

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

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

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

Figure 16a. RPSS for August–October 2009.

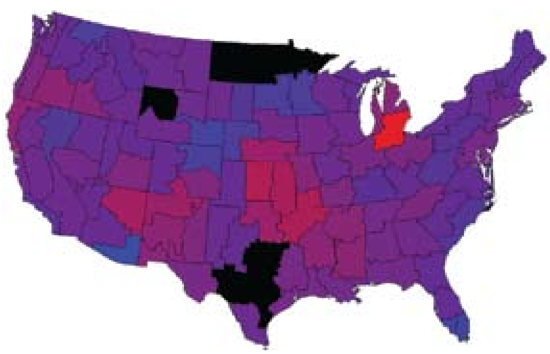
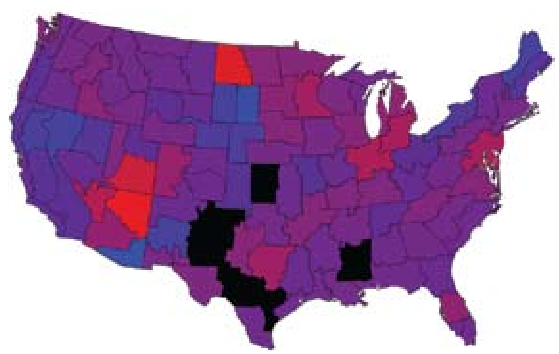


Figure 16b. RPSS for September–November 2009.



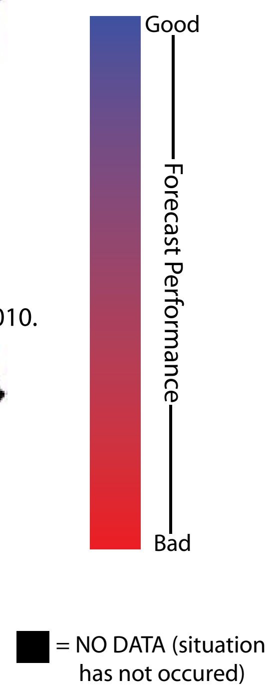


Figure 16c. RPSS for October–December 2009.

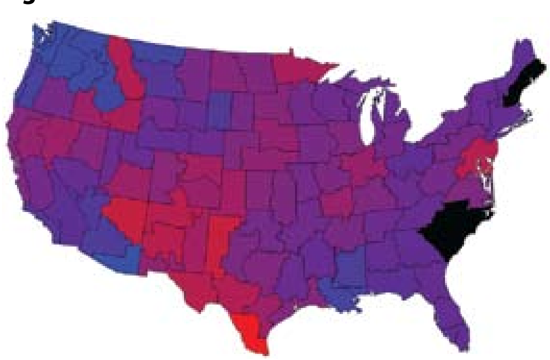
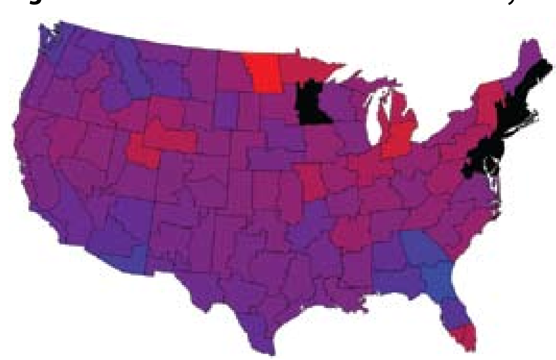


Figure 16d. RPSS for November 2009–January 2010.



On the Web:

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For a CLIMAS publication that explains how to use the Forecast Evaluation Tool, visit
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