Issued: April 24, 2009

Southwest Climate Outlook

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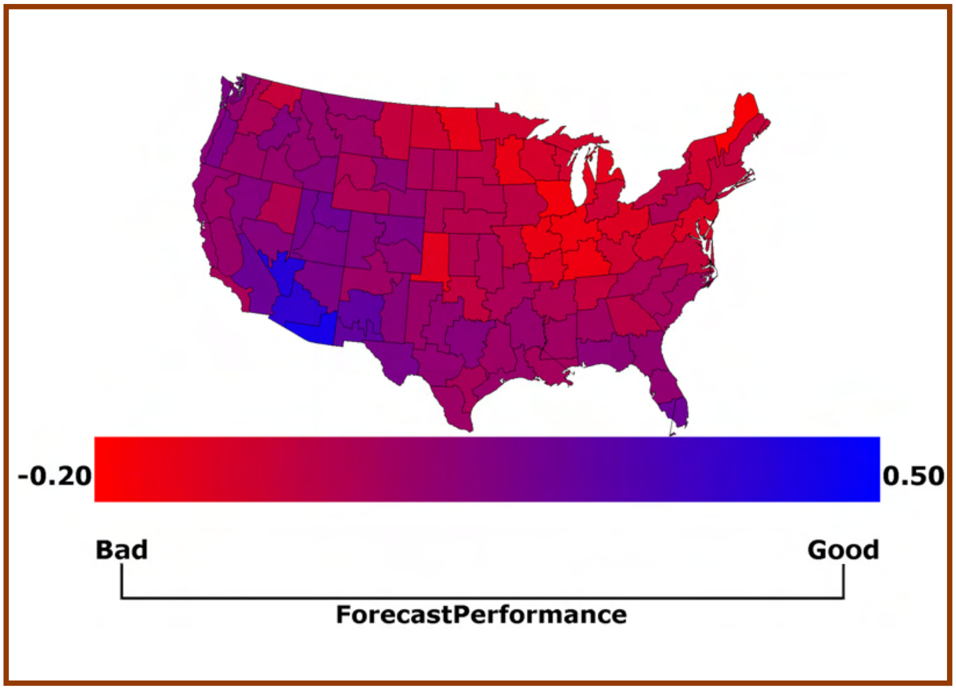

Source: Forecast Evaluation Tool

Photo Description: The new temperature and precipitation verification highlights incorporate a more sophisticated measure of forecast performance than the highlights featured in the past. (see pages 21–22). The new highlights display color maps like this one that help readers visualize the historical accuracy of the forecasts.

Would you like to have your favorite photograph featured on the cover of the *Southwest Climate Outlook*? For consideration send a photo representing Southwest climate and a detailed caption to: macaulay@email.arizona.edu

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In this issue...

April Climate Summary

Drought– Short-term drought conditions remained unchanged across northern Arizona, while worsening conditions were observed over the southeastern quarter of the state. For New Mexico, worsening drought conditions continued again this month; more than 60 percent of the state is experiencing some level of drought.

Temperature– The past 30 days brought a series of fairly dry cold fronts to the northern half of New Mexico and the northeast and northwest corners of Arizona, dropping temperatures as much as 3 degrees below average.

Precipitation– In the past 30 days, many parts of Arizona, and southern New Mexico had less than 25 percent of their average precipitation. Average precipitation since October 1 in many regions of both states has been less than 70 percent.

ENSO– The La Niña of 2008–2009 is almost over, and forecasts strongly support a quick move towards ENSO-neutral conditions over the next several months.

Climate Forecasts– The long-lead forecasts indicate the Southwest has increased chances for summer temperatures to be similar to the warmest 10 years of 1971–2000 and increased chances for precipitation through October to be similar to the wettest 10 years of 1971–2000.

The Bottom Line– Precipitation has been scant during the past 30 days. Mid-March to mid-April delivered less than 70 percent of average precipitation to most of the Southwest and only slightly more rainfall than mid-February to mid-March totals. As a result, drought conditions have expanded. Because April–June historically is very dry, the next sustained precipitation will likely not occur until the monsoon season Begins.

New Forecast Verification Highlights

In response to feedback from readers, the Southwest Climate Outlook has changed the temperature and precipitation forecast verification highlights. The new highlights incorporate the Forecast Evaluation Tool, which uses a common statistical method—the Rank Probability Skill Score (RPSS)—to verify forecasts. On page 6, a one-page summary discusses the RPSS and its use for evaluating the official long-lead forecasts issued each month by NOAA's Climate Prediction Center.

The new verification highlights presented here (see pages 21–22) have three advantages over the highlights featured in past issues. First, readers will understand the historical accuracy of the most current forecasts, providing information that can be useful for decisions based on those forecasts. The highlights that had been used in the outlook verified previously issued forecasts against past conditions, but knowing the accuracy of a forecast issued four months ago provides little value for future decisions. Second, the forecast verification method is now better. The new highlights rely on statistical comparisons instead of visual inspection. And finally, readers can now view the verification for four different forecasts, whereas previously the outlook presented the verification of only the one-month lead time.

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Stephanie Doster, *ISPE Information Specialist*
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Zack Guido, *CLIMAS Associate Staff Scientist*
Rebecca Macaulay, *Graphic Artist*
Kristen Nelson, *ISPE Associate Editor*
Nancy J. Selover, *Arizona State Climatologist*

This work is published by the Climate Assessment for the Southwest (CLIMAS) project and the University of Arizona Cooperative Extension; and is funded by CLIMAS, Institute for the Study of Planet Earth, and the Technology and Research Initiative Fund of the University of Arizona Water Sustainability Program through the SAHRA NSF Science and Technology Center at the University of Arizona.

Climate data: the ins and outs and where to find what

By Zack Guido

This article is the second in a two-part series. Part One, featured last month, discussed the National Weather Service's Cooperative Observer Program and the related Historical Climate Network. This article describes data from Remote Automated Weather Stations (RAWS) and the Arizona Meteorological Network (AZMET), and data generated by the Parameter-elevation Regressions on Independent Slopes Model (PRISM) statistical technique.

Not enough data is bad. Too much data is overwhelming. But not knowing what data exists and where to find it is worse.

Hundreds of weather stations in the Southwest dot the landscape, piping measurements to many different users. The National Weather Service (NWS), for example, intertwines the information in models that help forecast tomorrow's weather, while a coordinated group of federal wildfire agencies eyes data from different stations to monitor fire risk. The Arizona Cooperative Extension uses data from yet another network to derive "degree days" from temperature measurements, which allow farmers to estimate an outbreak of the infamous pink bollworm.

While climate and weather data support many actions, it is often difficult for users outside each data network's administration to track down and understand the data. Three networks—Remote Automated Weather Stations (RAWS), the Arizona Meteorological Network (AZMET), and data generated by a sophisticated algorithm called the Parameter-elevation Regressions on Independent Slopes Model (PRISM)—offer detailed data that may have gone unnoticed to some.

While RAWS and AZMET capture extreme conditions and weather representative of agricultural areas, PRISM meshes observations from several networks into a mathematical model that estimates climate for small grid-boxes that span the entire U.S. All three, along with the Cooperative Observer Programs (Coop) and the Historical Climate Network (HCN), which were discussed in the March *Southwest Climate Outlook*, can help researchers understand climate change, businesses relate product demand to climate, and resource managers dole water to irrigation districts, among other uses.

Remote Automated Weather Stations

The RAWS network was established principally to help fire managers predict fire behavior and monitor the conditions of fuels, such as standing and fallen trees. As a result, the stations have been systematically located in remote areas that capture extreme conditions, including windy areas and sites that receive a hefty dose of sunlight—areas that are the most susceptible to fire. RAWS are generally not sited on northern facing slopes, which receive less sunlight than southern aspects. While RAWS are predominantly used for fire-risk assessments, the data also assist in air quality monitoring and research.

Nearly 2,200 RAWS are strategically located throughout the United States. There are 130 stations in Arizona and New Mexico, and the oldest stations have been active since the mid-1980s. Most RAWS are operated by the wildland fire agencies, such as the National Forest Service, the Bureau of Land Management, and the U.S. Fish and Wildlife Service.

RAWS record weather conditions every minute to every hour, depending on the variable being measured, and transmit the information via satellite to the National Interagency Fire Center and the Western Regional Climate Center (WRCC). This allows users to obtain real-time information. Most RAWS record temperature, precipitation, wind speed and direction, barometric pressure, and relative humidity; some stations also record the moisture and temperature of fire fuels. The data are free and most easily accessed at the WRCC.

The RAWS data have some limitations. First, the data available to the public are not quality controlled. The raw values recorded at the stations are the same as those archived at the WRCC. Second, not all stations in the western U.S. continuously collect data—some stations sleep in the winter when fire risk is low, particularly those at higher elevations. In addition, some stations are portable and are moved during the year and between years. Because micro climate can impact weather conditions, data from portable stations are not useful for long-term analysis without careful inspection. Furthermore, some RAWS data are not well annotated, making it difficult to decipher which stations moved and the site characteristics of the new and old locations.

Like all networks, RAWS have a specific purpose, which influences how data is recorded. To monitor fire risk, for example, wind speeds are measured at a height of 20 feet and are averaged over 10 minutes. Weather stations at airports, in contrast, measure wind speeds at 33 feet and the values are averaged over two-minutes. Knowing these and other RAWS data issues can help make this detailed dataset useful.

Arizona Meteorological Network

AZMET—a service of the Cooperative Extension at The University of Arizona— provides meteorological data and weather-based information to agricultural and horticultural interests operating in southern and central Arizona. Each hour, AZMET stations record numerous climate and weather variables that have been useful for irrigation districts, golf courses, cotton and citrus growers, fertilizer and pesticide companies, researchers, and others.

continued on page 4

Climate data, continued

The earliest AZMET stations began operating in 1987, and 28 stations are currently active. The stations are located in both rural and urban agricultural areas and are often positioned in open spaces over grass and away from buildings. As a result, the data is not as affected by urban heat island effects, which can amplify temperature and alter other climate variables. One asset of AZMET is that it measures many climate and weather variables, including air temperature, soil temperature at two depths, precipitation, wind speed and direction, solar radiation, and humidity. From those measurements, AZMET calculates heat units and chill hours, which help characterize the life stages of plants, and evapotranspiration. Because the data are recorded hourly, the dataset is rich and detailed. Furthermore, AZMET stations measure climate and weather variables not collected by other networks, including evapotranspiration. A census of data collection organizations indicates that AZMET is the only network to monitor evapotranspiration continuously in Arizona.

Another positive feature of the AZMET network is that stations are well maintained, which helps create consistent data. A technician visits each site at least every three months and erects a temporary station with laboratory-calibrated sensors. A comparison of the results between the official and temporary stations helps AZMET evaluate the reliability of the data and ensure accurate measurements. In addition, AZMET changes the wind speed and solar sensors each year and changes the temperature and humidity sensor every two years to prevent sensor failure or measurement drift. Many other networks change equipment only after problems occur, often making it difficult to locate in the data when values became inaccurate.

AZMET data also are quality controlled, although not as rigorously as the HCN network. Most quality control is performed by computer statistical analysis, in which measurements are cross-checked with nearby stations to make sure that one station is not recording artificial conditions. Additional computer programs comb the data for negative values or uncharacteristically extreme values. The presence of these anomalies tells technicians to review the data manually. Each morning at about one a.m., the data is transferred onto a Web server where it is free and available to the public.

Like RAWS, however, AZMET data have limitations. First, the period of record is relatively short: a maximum of 22 years, and only 12 stations span this period. AZMET data is therefore not as useful for deriving long-term climate trends as other networks such as the

Network	Data Source	Climate Variables	Recording Intervals	Record Length	Primary Application	Quality Control
Coop	12,000 active Coop stations; ~170 in AZ and ~180 in NM	1. Maximum temp. 2. Minimum temp. 3. Daily total precip. 4. Daily total snow 5. Others	Once a day	1880 – present; varies by station	Support public services with near real-time data	Some quality control after data acquisition
HCN	1,221 stations selected from Coop network	1. Maximum temp. 2. Minimum temp. 3. Daily total precip. 4. Daily total snow	Once a day	Most stations have data for 80 years or more	Detect and monitor changes in regional climate	Extensive quality control after data acquisition
RAWS	2,200 remote automated stations; 130 in AZ and NM	1. Temperature 2. Precipitation 3. Wind speed 4. Relative humidity 5. Others	Minute to hourly	Many stations became active in the mid-1980s	Monitor fire-risk	No quality control
AZMET	28 automated stations in rural and urban areas in AZ	1. Temperature 2. Precipitation 3. Evapotranspiration 4. Others	Hourly	1986 – present; varies by station	Support agriculture and horticulture in southern and central Arizona	Some quality control after data acquisition; routine station maintenance
PRISM	Coop, SNOTEL, local stations, and statistically generated data	1. Maximum temp. 2. Minimum temp. 3. Average temp. 4. Precipitation	Monthly	1895 – present	Produce detailed, high-quality spatial climate datasets	Depends on data source

Coop: Cooperative Observer Program; HCN:Historical Climate Network; AZMET: Arizona Meteorological Network; PRISM: Parameter-elevation Regressions on Independent Slopes Model; RAWS: Remote Automated Weather Stations; SNOTEL: snow telemetry

Table 1. Characteristics of common sources of climate and weather data.

continued on page 5

Climate data, continued

HCN. Also, the station density is sparse, except in the Phoenix area, and the data is predominantly limited to southern and central Arizona. Finally, the data is representative of agricultural locations, providing information that is suitable for aiding agricultural decisions but not as appropriate for understanding the climate of ranchlands or assessing the urban heat island as other data sources.

Parameter-elevation Regressions on Independent Slopes Model

All monitoring stations, including Coop, HCN, RAWS, and AZMET, measure weather and climate conditions at a location. But climate can vary dramatically across short distances and over small elevation changes. Even Coop, which has 170 active stations in Arizona, cannot adequately cover the entire state. What about the weather in areas between the stations?

To fill in data gaps between stations, Oregon State University developed PRISM, an observation-based statistical algorithm that uses measurements made at monitoring stations from several data networks. PRISM generates climate data for a 2.5 by 2.5 mile (or four-kilometer) grid that covers the continental United States.

The PRISM model computes climate values in a sophisticated way. Essentially, the model overlays a grid on a three-dimensional relief map of the U.S. and marks the grid-boxes containing monitoring stations. It then assigns the observed values for precipitation, temperature, and other variables to each box with an established station. After this, boxes remain that do not have stations. PRISM populates these grids with climate values, for each box, derived from the unique relationship between climate and elevation, coastal proximity, topography, distance to known observations, and aspect. The PRISM algorithm is specifically designed to generate realistic climate data for areas prone to complex weather, such as mountainous regions, places in rain shadows, and regions near water.

PRISM has been used to create a continuous monthly climate data for 1895 to the present. The length of record and the fine spatial resolution make PRISM data unique, meeting the needs of resource managers, land-use planners, researchers, and many other stakeholders.

PRISM data, however, have some drawbacks. Monitoring stations at higher elevations are few and far between, and therefore some people believe that PRISM data for higher elevations is less reliable. Also, any statistical procedure introduces additional sources of error. In addition, only monthly data are available.

Until recently, PRISM data were not easily analyzed without specialized software. However, the need for more accessible, fine-scale climate datasets spawned the Western Climate Mapping Initiative (WestMap), a collaborative effort between The University of Arizona, The Desert Research Institute, and Oregon State University. CLIMAS also played a role, helping identify demand for Web-based PRISM data.

WestMap has developed a Web-based climate analysis and mapping tool that enables users to download and graphically display PRISM data for the western U.S. The tool allows users to query data for different time periods and regions, download the data in a common format, and create maps and charts. For example, users can obtain monthly data for any period between 1895 and the present for a user-defined area, such as a single location, an entire state, or a watershed. Users may also create custom maps to suit their needs.

Conclusion

Weather and climate data come from many sources and possess unique qualities. While stations in the RAWS network are in remote, sun-baked areas, PRISM sites are virtual. While many HCN stations span more than 80 years, AZMET stations have made measurements since 1987. And while Coop stations and RAWS have minimal quality control, HCN and AZMET are processed with a finer-tooth comb.

Regardless of which networks are used, however, knowing the ins and outs of each will help match the proper dataset to the question at hand and can help enable businesses, farmers, researchers, natural resource managers, and others to more effectively make decisions.

For questions or comments, please contact Zack Guido, CLIMAS Associate Staff Scientist, at zguido@email.arizona.edu or (520) 882-0879.

Related Links

Arizona Meteorological Network

1. Access all AZMET data and encounter more information: http://ag.arizona.edu/AZMET/

Remote Automated Weather Stations

1. Access data through a map interface, hosted by Western Regional Climate Center: http://www.raws.dri.edu/index.html

2. RAWS home page provides overview of RAWS program: http://www.fs.fed.us/raws/

PRISM

1. User-friendly graphical interface for accessing PRISM data for Western U.S., developed by WestMap: http://www.cefa.dri.edu/Westmap/Westmap_home.php

2. Access datasets for entire U.S. via Oregon State University: http://www.prism.oregonstate.edu/

Evaluating forecasts with the RPSS

By Zack Guido

In response to user feedback, the Southwest Climate Outlook has changed its temperature and precipitation forecast verification highlights to incorporate a more accurate evaluation method, the Rank Probability Skill Score (RPSS). To the mathematically wary, this name likely causes anxiety. Indeed, the RPSS is an equation and is complicated. But it helps answer a critical question: have the forecasts been accurate? Knowing this helps users incorporate the forecasts into decisions, such as when to purchase hay to avoid high costs or how much water to dole to irrigation districts.

Scientists often evaluate a forecast by calculating its skill, which is the accuracy of a forecast in relation to another, reference forecast. A "skillful" forecast shows improvement over the reference forecast. For example, a poker player may say he or she can beat the house more often than losing. If the game played has 50:50 odds, the poker player must win more than 50 percent of the games to show skill over the odds (the reference forecasts).

The National Oceanic and Atmospheric Administration's Climate Prediction Center (NOAA-CPC) began forecasting successive three-month periods in 1994, and these forecasts spanned two weeks to 13 months into the future. But the usefulness of these forecasts depends on their accuracy. If the forecasts have been historically worse than simply using a coin to predict the weather, than what value do they have?

To help address this question for readers, the Southwest Climate Outlook verification pages will present the average RPSS calculated for all the temperature and precipitation forecasts issued since 1994 for four different lead times. The RPSS is calculated by the Forecast Evaluation Tool, which was developed by The University of Arizona in partnership with NOAA, NASA, the National Science Foundation, and the University of California-Irvine.

In essence, the RPSS communicates how much more or less accurate the CPC forecasts have been than the reference forecast. The reference forecast for the CPC forecasts is equal probabilities that temperatures or precipitation will be one of three categories—"above," "below," or "neutral"—or a 33 percent chance for each category. These forecasts give probabilities, for example, that temperature will be similar to the 10 warmest, coolest, or normal temperatures observed during the period 1971–2000. This equal probability is often referred to as a climatology forecast.

The actual formula of the RPSS is complicated and is beyond the scope of this article. The two important characteristics of the RPSS, however, are easily articulated. First, the higher the RPSS value, the better the forecast; the RPSS value is the percent improvement the forecast exhibits over the reference forecast. Positive values also give an indication that the forecasts and the actual weather conditions are similar—the higher the RPSS, the more similar the forecast and the actual conditions. Negative values, on the other hand, mean that the forecast is less accurate than the climatology forecast.

Second, the value of the RPSS incorporates the degree of correctness or incorrectness. This "ranked" scoring system values correct forecasts and incorrect forecasts differently—some inaccurate forecasts are worse than others. For example, if a forecast indicated a 90 percent chance for "above" temperatures but temperatures were actually "below," the RPSS would be lower than if the forecast stated a 40 percent chance for "above" temperatures.

The usefulness of forecast verifications such as the RPSS becomes apparent in the example of an early forecaster. In 1884, Sergeant John Finley began forecasting tornado occurrences east of the Rocky Mountains. Shortly thereafter, he reported a 95.6–98.6 percent forecast accuracy. Other scientists, however, pointed out that the accuracy could have been 98.2 percent had he simply always forecasted no tornados. Although Finley's forecasts seemed accurate, they were not the best forecasts. Had an RPSS been calculated, it would have been negative.

While forecasts will continue to be made—each additional year helps make the RPSS more robust—knowing the accuracy of past forecasts will help evaluate the usefulness of the current forecast.

For questions or comments, please contact Zack Guido, CLIMAS Associate Staff Scientist, at zguido@email.arizona.edu or (520) 882-0879.

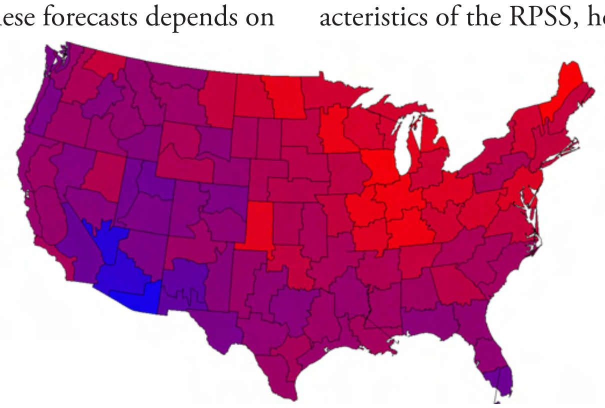


Figure 1. The new verification highlights incorporate a more sophisticated measure of forecast performance than the highlights featured in the past. The new color maps like this one that help readers visualize the historical accuracy of the forecasts.

Temperature (through 4/15/09)

Source: High Plains Regional Climate Center

Temperatures since the water year began October 1 have been neatly divided by elevation in Arizona, averaging below 45 degrees Fahrenheit on the Colorado Plateau and more than 55 degrees in the southwestern deserts and along the lower Colorado River (Figure 1a). The highest elevations in northern Arizona have had average temperatures below 40 degrees. In New Mexico, the northern two-thirds of the state have had average temperatures below 50 degrees, with the highest elevations below 40 degrees. The southern third of the state has had average temperatures between 50 and 55 degrees. The warming has led to an earlier-than-normal snowmelt. These temperatures have been 0 to 3 degrees above average for the water year across most areas of both states. Temperatures in New Mexico have been 3 – 5 degrees above average in the southwestern mountains near Silver City and in the northeast corner (Figure 1b).

The past 30 days brought a series of fairly dry cold fronts to the northern half of New Mexico and the northeast and northwest corners of Arizona, dropping temperatures as much as 3 degrees below average (Figures 1c–d). In contrast, southern Arizona and New Mexico have been 2 – 3 degrees above average, with the White Mountains in southeast Arizona ranging from 4 to 5 degrees above average. After an early, wet winter, conditions turned warm and dry in February and early March, but late March and early April brought a return of cold fronts to the Southwest.

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 April 15, 2009) average temperature.

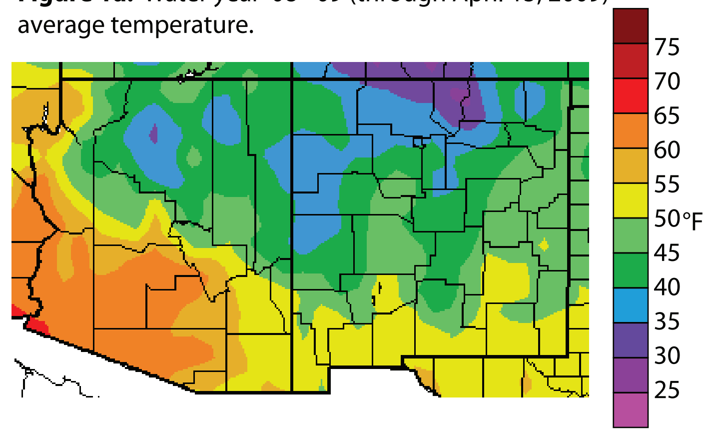


Figure 1b. Water year '08–'09 (through April 15, 2009) departure from average temperature.

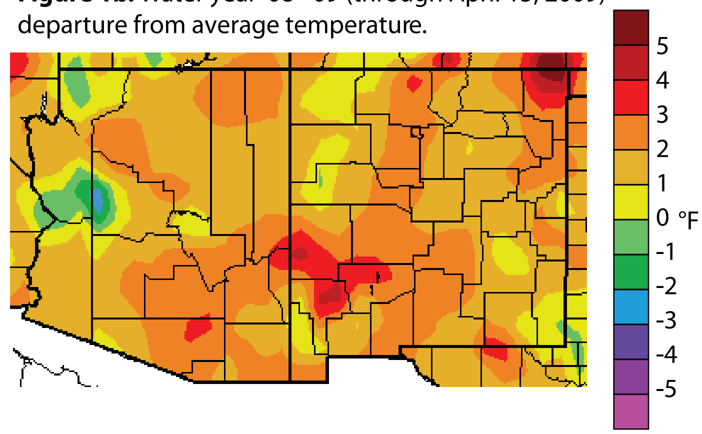


Figure 1c. Previous 30 days (March 17–April 15, 2009) departure from average temperature (interpolated).

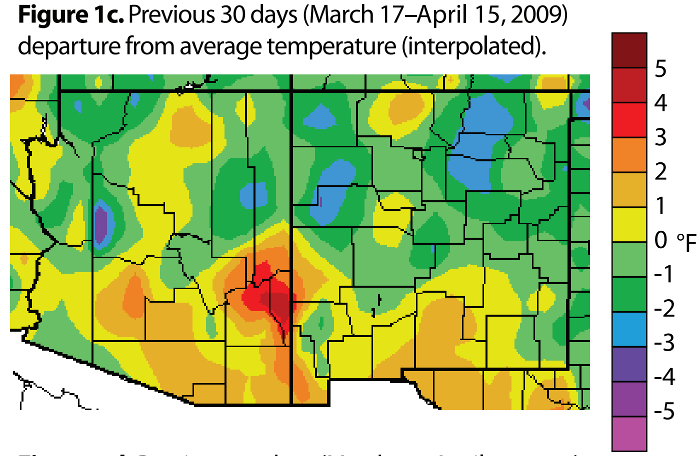
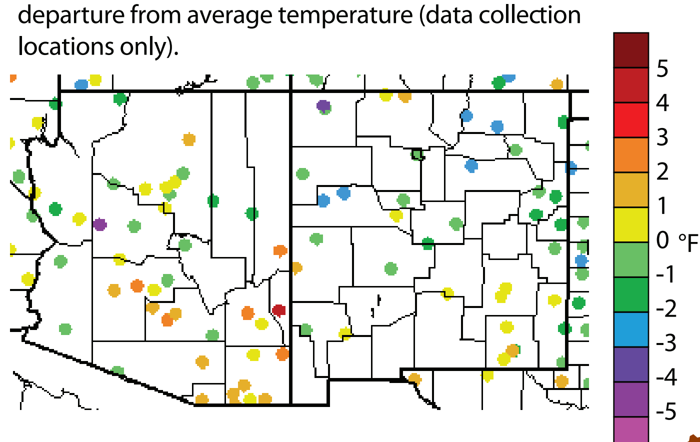


Figure 1d. Previous 30 days (March 17–April 15 2009) departure from average temperature (data collection locations only).



Precipitation (through 4/15/09)

Source: High Plains Regional Climate Center

Since the water year began October 1, precipitation has been well below average in the Southwest. Across Arizona precipitation has averaged 25 – 90 percent, while most of the southern half of New Mexico has received 5 – 70 percent of average (Figures 2a–b). Parts of northwestern and southwestern Arizona, along the lower Colorado River, and the mountains of northern and eastern New Mexico have received 90 – 150 percent of average precipitation. Although numerous storm systems have passed through, there has been very little moisture available for precipitation since mid-February, and the large snowpack that fell in early winter has nearly melted.

In the past 30 days, western, southern and central Arizona and southern New Mexico had less than 25 percent of their average precipitation (Figures 2c–d). The lower elevations of central and northern New Mexico had 50 to 90 percent of average precipitation, and the highest elevations of northern and eastern New Mexico received 100 to 300 percent of average. The recent low pressure system on April 11–12 brought the first measurable rain in more than a month to Albuquerque and most of central and northern Arizona. Northeastern New Mexico and northeastern Arizona had a significant winter storm on March 26–27, with several locations receiving between a quarter and half an inch of rainfall. Most of the recent winter storms have brought high winds to the northern portions of both states but little precipitation.

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 April 15, 2009) percent of average precipitation (interpolated).

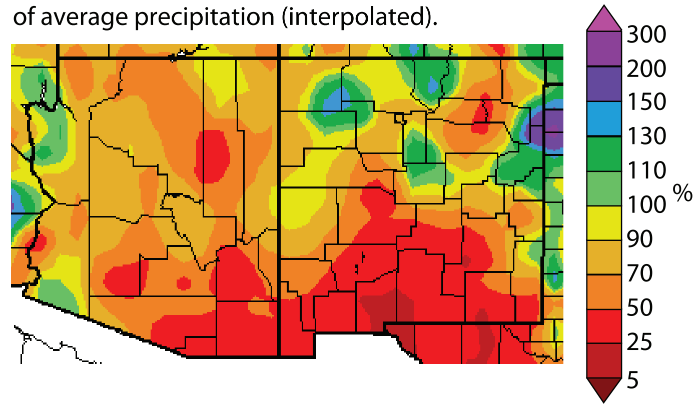


Figure 2b. Water year '08–'09 (through April 15, 2009) percent of average precipitation (data collection locations only).

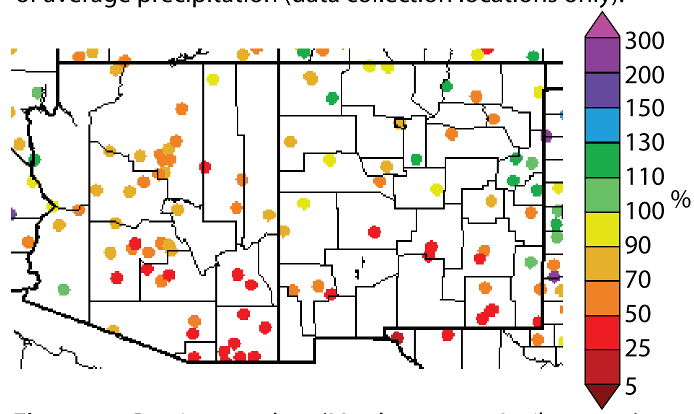


Figure 2c. Previous 30 days (March 17, 2009–April 15, 2009) percent of average precipitation (interpolated).

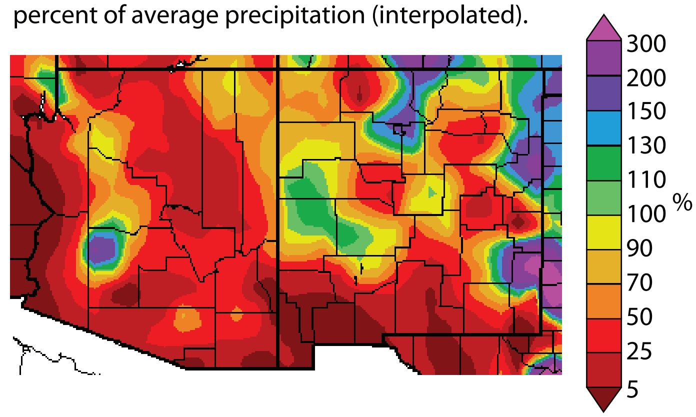
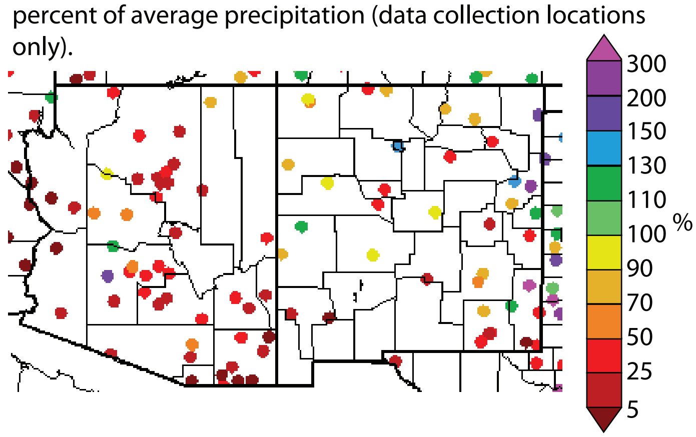


Figure 2d. Previous 30 days (March 17, 2009–April 15, 2009) percent of average precipitation (data collection locations only).



U.S. Drought Monitor
(released 4/16/09)

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

The U.S. Drought Monitor reports worsening conditions for the Four Corners region and southern New Mexico (Figure 3). The drought status across Arizona and New Mexico has been influenced by a dry month in which most of Arizona and New Mexico have received less than 50 percent of their average precipitation. In southern New Mexico, some areas are experiencing severe drought. Elsewhere, large portions of Texas remain in severe, extreme, and exceptional drought; the state saw few changes from one month ago. In California, the extreme drought intensity has expanded from one month ago and now occupies a large area from the central to northern part of the state.

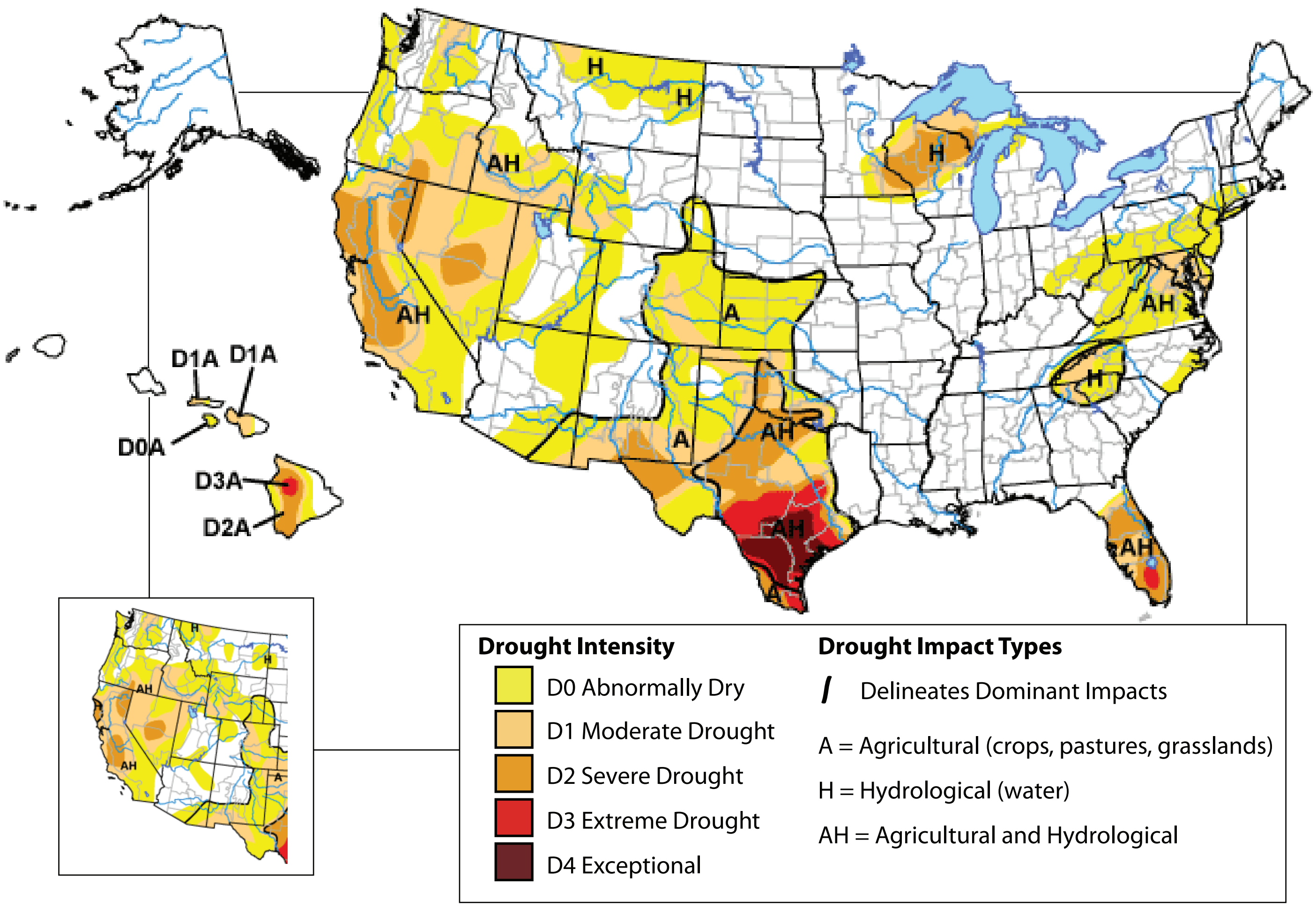
On April 14, approximately 43 percent of Arizona had no drought classification, while about 55 percent was abnormally dry. In the past two months, the total area in the state with a drought intensity increased from about 21 to 57 percent. In New Mexico, about 38 percent of the state had no drought status on April 14. About 26 percent was abnormally dry, about 29 percent had moderate drought intensity, and about 7 percent had severe drought. In the past month, the total area in the state with a drought intensity increased by about 7 percent.

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 the several agencies; the author of this monitor is Richard Heim, NOAA/NESDIS/NCDC.

Figure 3. Drought Monitor released April 16, 2009 (full size), and March 19, 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

(data through 2/28/09)

Source: Arizona Department of Water Resources

Short-term drought conditions remained unchanged across northern Arizona, while worsening conditions were observed over the southeastern quarter of the state, according to the March Arizona Drought Monitor Report (Figure 4). Abnormally dry drought status persisted again this month for many of the watersheds in northern Arizona except for the Upper Colorado River watershed, which has no current drought classification. Abnormally dry conditions expanded across southern Arizona, downgrading the San Simon and Upper Gila River watersheds to abnormally dry conditions. Similar to last month, the most intense drought conditions were in the Willcox Playa and White Water Draw watersheds, which are experiencing moderate drought. The Santa Cruz watershed also fell to this drought category in March from abnormally dry conditions in February. Below-average precipitation ranging from 25 to 75 percent of average in February is to blame for the worsening drought conditions across the southeastern part of the state.

A recent study conducted at The University of Arizona's Biosphere 2 research facility concluded that warming temperatures can increase tree mortality, conforming with recent observations across the Southwest U.S. The experiment subjected mature piñon-juniper trees to different levels of temperature and water stress. The trees that experienced 4 degrees C warmer temperatures but the same amount of precipitation died faster than the control group. This suggests that moderate drought conditions, which occur frequently across Arizona and New Mexico, would be able to push large-scale tree mortality events as temperatures continue to warm across the region.

Notes:

The Arizona drought status maps are produced monthly by the Arizona Drought Preparedness Plan Monitoring Technical Committee. The maps are based on expert assessment of variables including, but not limited to, precipitation, drought indices, reservoir levels, and streamflow.

Figure 4a shows short-term or meteorological drought conditions. Meteorological drought is defined usually on the basis of the degree of dryness (in comparison to some "normal" or average amount) over a relatively short duration (e.g., months). Figure 4b refers to long-term drought, sometimes known as hydrological drought. Hydrological drought is associated with the effects of relatively long periods of precipitation shortfall (e.g., many months to years) on water supplies (i.e., streamflow, reservoir and lake levels, and groundwater). These maps are delineated by river basins (wavy gray lines) and counties (straight black lines).

On the Web:

For the most current Arizona drought status maps, visit:
http://www.azwater.gov/dwr/drought/DroughtStatus.html

Figure 4a. Arizona short-term drought status for March 2009.

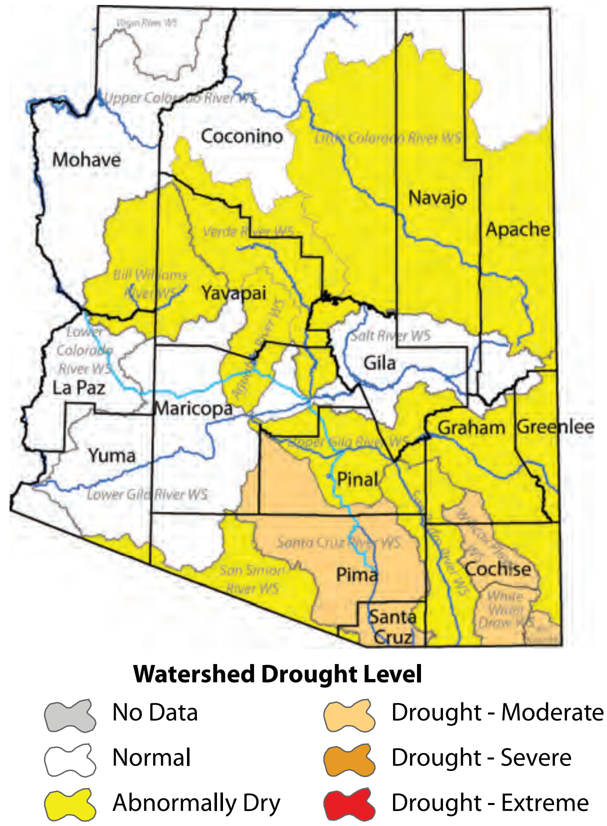
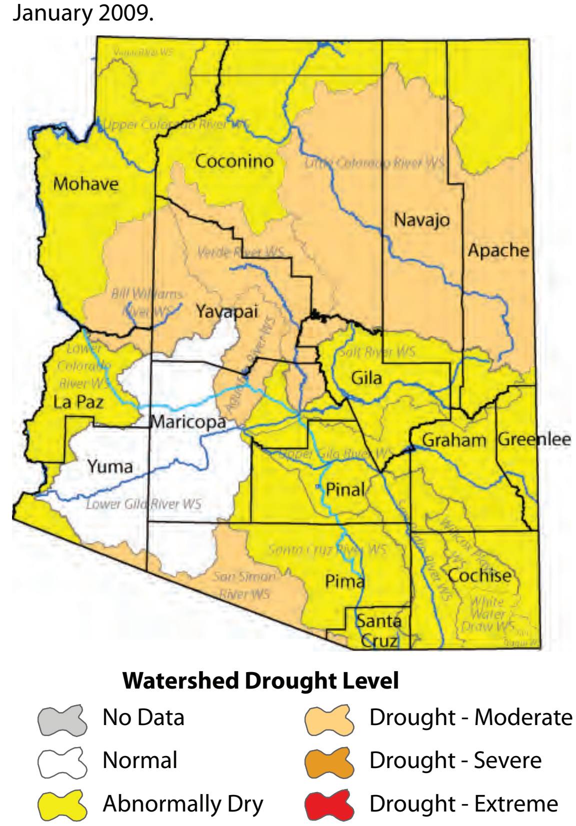


Figure 4b. Arizona long-term drought status for January 2009.



New Mexico Drought Status

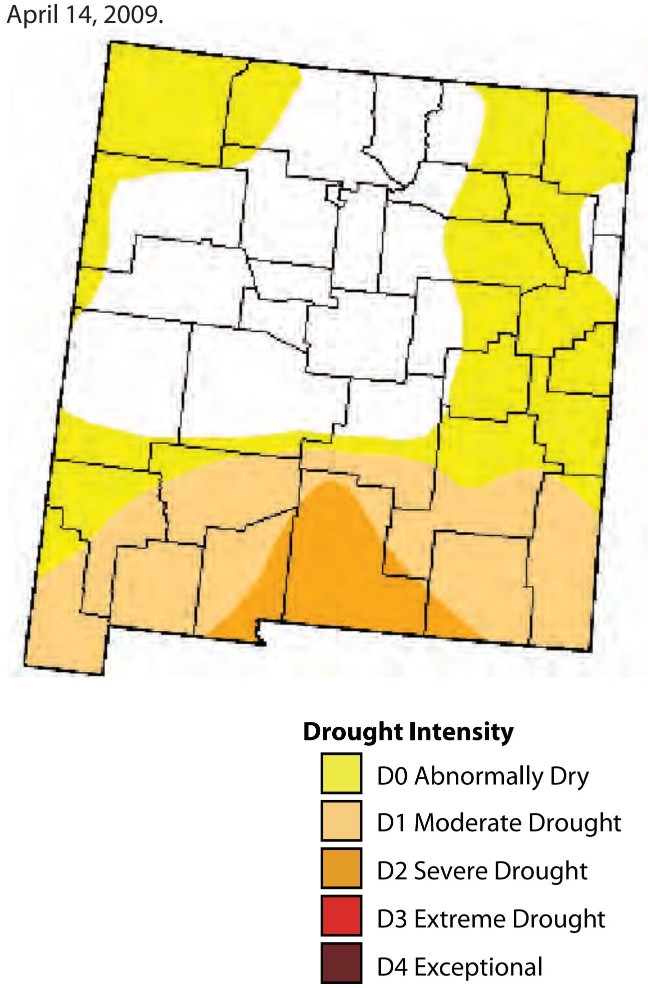
(released 4/16/09)

Source: New Mexico State Drought Monitoring Committee

The slide towards worsening drought conditions continued again this month with more than 60 percent of New Mexico experiencing some level of drought (Figure 5). The April 14 update of the National Drought Monitor depicted abnormally dry conditions across the northeast and far northwest corners of the state. Moderate drought expanded across much of the southern third of New Mexico over the past month, with severe drought conditions developing in the south-central region (primarily in Otero County). Drought conditions have continued to worsen over the past several months across southern New Mexico due to well below-average precipitation for the winter season. Observed precipitation totals are less than 25 percent of average for January to March across this area.

Wildland fire fighters are bracing for a busy fire season across eastern New Mexico. They point to the combination of drought conditions, extreme fuel loads of dry grasses, and frequent high wind events as the necessary ingredients for extreme, large fire events. Local fire departments in Clovis and Portales have been preparing through the winter for this upcoming season by participating in and recently completing a 12-week wildland fire fighting training program. They note that this program provides specialized training for fighting fires in open range lands, which behave differently than the structure fires they typically encounter (*The Portales News-Tribune*, April 4).

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



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 the 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 3/31/09)

Source: National Water and Climate Center

Combined reservoir storage in Lakes Powell and Mead declined by 529,000 acre-feet during March (Figure 6), dropping below 50 percent of the combined capacity of the two massive reservoirs. Nevertheless, their combined storage is about 1.2 million acre-feet greater than it was the same time last year. During March, storage in the Salt River watershed remained at 100 percent of capacity. The combined storage in the Salt-Verde reservoir system increased by 22,700 acre-feet.

The elevation by May of water in Lake Mead is projected to drop below 1,100 feet for the first time since 1965 (*Las Vegas Review-Journal*, April 14). Without substantial late spring precipitation, Lake Mead is likely to drop even further by July, the end of the snowmelt runoff season.

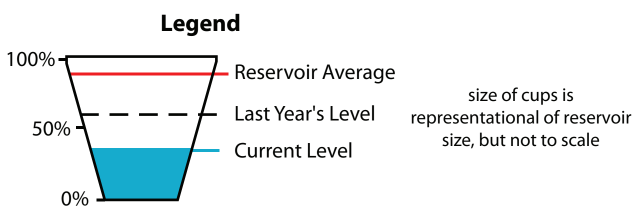
Notes:

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.

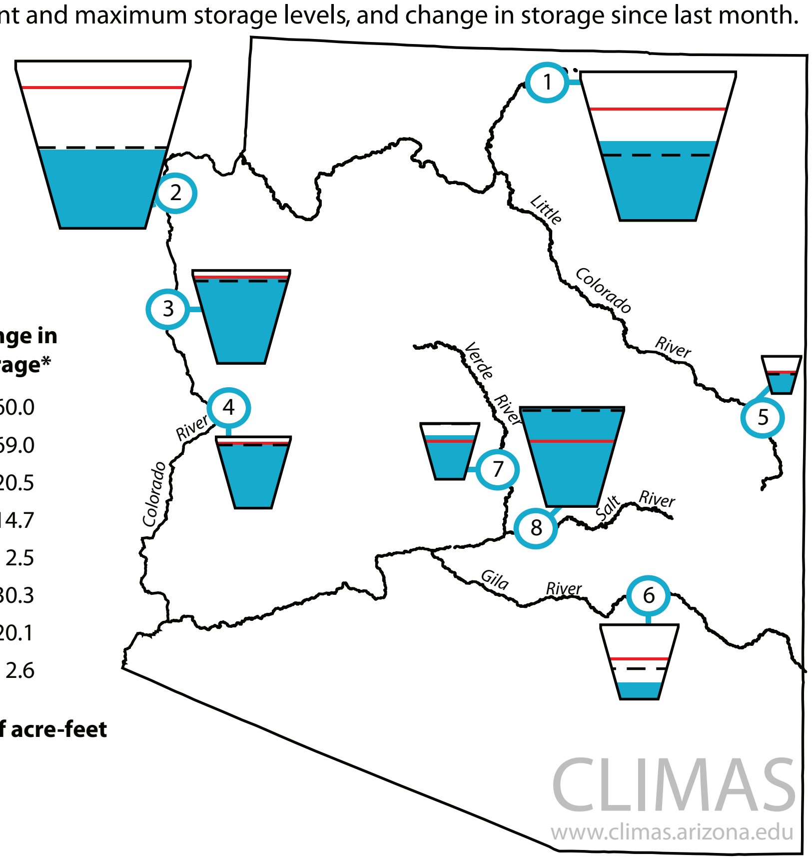
These data are based on reservoir reports updated monthly by the National Water and Climate Center of the U.S. Department of Agriculture's Natural Resource Conservation Service (NRCS). For additional information, contact Dino DeSimone, Dino.DeSimone@az.usda.gov.

Figure 6. Arizona reservoir levels for March 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	53%	12,774.0	24,322.0	-160.0
2. Lake Mead	47%	12,164.0	26,159.0	-369.0
3. Lake Mohave	91%	1,654.7	1,810.0	-20.5
4. Lake Havasu	90%	556.5	619.0	14.7
5. Lyman Reservoir	57%	17.1	30.0	2.5
6. San Carlos	23%	201.1	875.0	-30.3
7. Verde River System	79%	226.6	287.4	20.1
8. Salt River System	100%	2,019.9	2,025.8	2.6

*** thousands of acre-feet**



On the Web:

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

New Mexico Reservoir Levels

(through 3/31/09)

Source: National Water and Climate Center

The total reservoir storage in New Mexico decreased by 26,500 acre-feet during March (Figure 7). Elephant Butte Reservoir is now at 29 percent of capacity. Navajo Reservoir, which currently has the largest volume of water in New Mexico, is at 76 percent of capacity—down slightly from last year. Storage in Pecos River reservoirs (reservoirs 9–12 on Figure 7) decreased during the last month.

In water-related news, a plan by Borrendo LLC will pipe water 150 miles from rural New Mexico to Santa Fe and other cities (Associated Press, April 10). To facilitate the exchange, five eastern New Mexico farmers have agreed to transfer their water rights to about two billion gallons per year, pending review by the New Mexico State Engineer's Office.

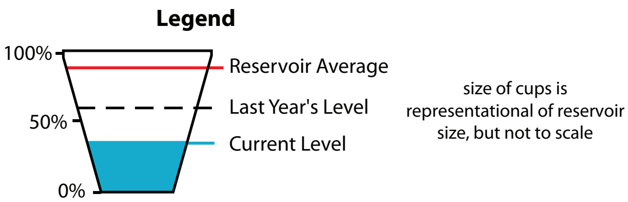
Notes:

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).

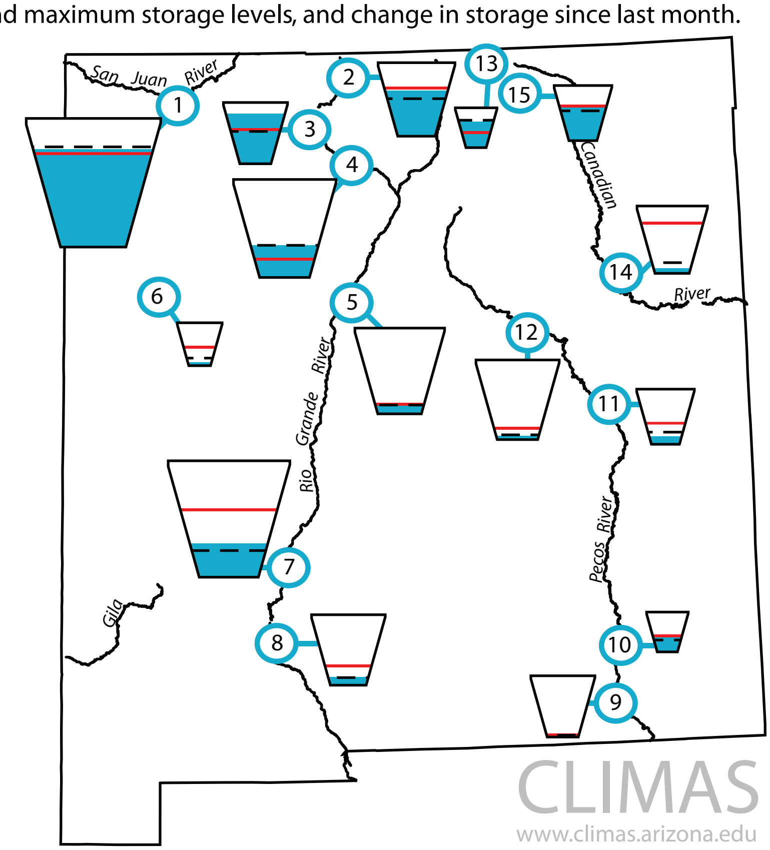
The table details more exactly the current capacity level (listed as a percent of maximum storage). Current and maximum storage levels are given in thousands of acre-feet for each reservoir. One acre-foot is the volume of water sufficient to cover an acre of land to a depth of 1 foot (approximately 325,851 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 March 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	76%	1287.1	1,696.0	27.7
2. Heron	62%	248.5	400.0	4.1
3. El Vado	82%	159.3	195.0	-2.8
4. Abiquiu	33%	181.0	554.5	-0.8
5. Cochiti	10%	50.6	491.0	-0.7
6. Bluewater	8%	3.0	38.5	0.4
7. Elephant Butte	29%	626.6	2,195.0	-41.1
8. Caballo	12%	39.5	332.0	-4.0
9. Brantley	3%	29.7	1008.2	8.0
10. Lake Avalon	38%	1.5	4.0	-1.4
11. Sumner	15%	15.7	102.0	-8.8
12. Santa Rosa	5%	23.4	438.3	-8.3
13. Costilla	65%	10.4	16.0	0.6
14. Conchas	8%	20.6	254.2	-1.0
15. Eagle Nest	63%	49.4	79.0	1.6



CLIMAS
www.climas.arizona.edu

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 4/17/09)

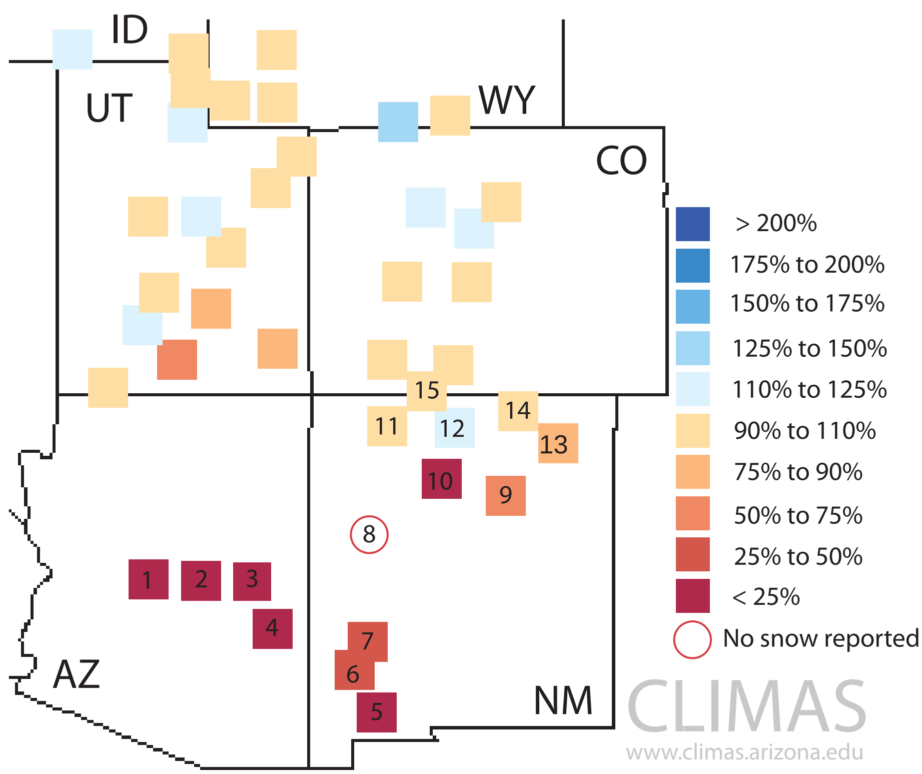
Sources: National Water and Climate Center, Western Regional Climate Center

Snowpack levels remained well below average and continued to decline during the past 30 days in the high country areas in Arizona and New Mexico (Figure 8). Above-average temperatures in mountainous areas and below-average precipitation helped push the early spring melt, especially across Arizona and parts of southwestern New Mexico. Most SNOTEL (Snowpack Telemetry) sites in Arizona are reporting snow water content (SWC) values of less than 25 percent of average fore mid-April. Several SNOTEL sites along the Mogollon Rim are reporting no snowpack at all.

Low snowpack levels are also prevalent in southern New Mexico, while the northern part of the state is in better shape. Cooler temperatures and near-average winter precipitation in the Rocky Mountains near the New Mexico-Colorado border have helped maintain near-average snowpack levels for mid-April. Forecasts suggest that this snowpack will help support near-average streamflows through the spring on the upper Rio Grande. The rest of the Southwest is expected to see well below-average streamflows due to low April snowpack.

In the Colorado Rockies, from which much of the Colorado River water originates, many SNOTEL sites report near-average SWC.

Figure 8. Average snow water content (SWC) in percent of average for available monitoring sites as of April 17, 2009.



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.

Figure 8 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–October 2009)
Source: NOAA Climate Prediction Center (CPC)

The NOAA-Climate Prediction Center (NOAA-CPC) long-lead temperature forecasts for the U.S. show increased chances for spring and summer temperatures in the Southwest to be similar to the warmest 10 years of the 1971–2000 climatological record (Figures 9a–d). Most of the forecast tools suggest an increased likelihood through at least August for relative warmth across the Southwest, extending eastward into the central and southern Plains and northward into Oregon and Idaho. The remaining long-lead forecasts, based on these forecast tools and long-term trends, also indicate warm conditions throughout much of the West.

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 2009.

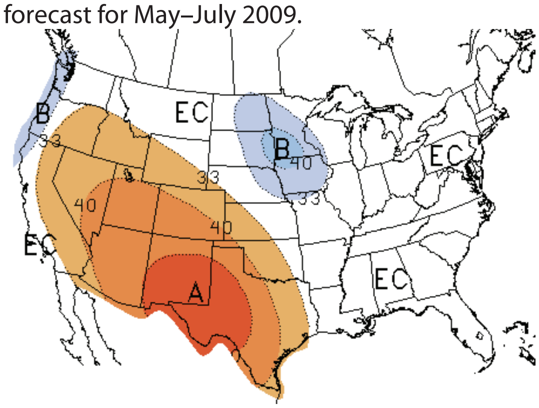
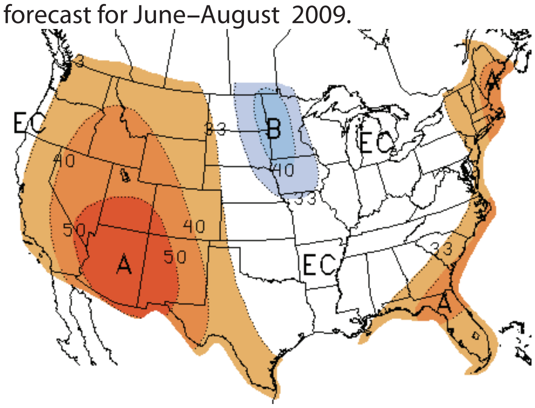


Figure 9b. Long-lead national temperature forecast for June–August 2009.



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 9c. Long-lead national temperature forecast for July–September 2009.

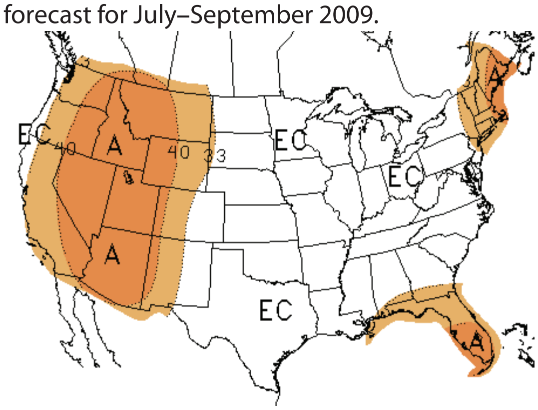
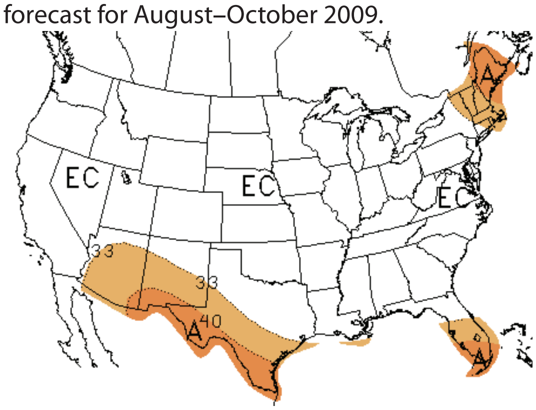


Figure 9d. Long-lead national temperature forecast for August–October 2009.



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

(May-October 2009)

Source: NOAA Climate Prediction Center (CPC)

The NOAA-Climate Prediction Center (NOAA-CPC) long-lead precipitation forecasts for May through October show increased chances for precipitation in Arizona and parts of New Mexico to be similar to the wettest 10 years of the 1971–2000 climatological record (Figures 10a–d). The forecasts tip slightly in favor of a wet monsoon season for the Southwest even though predicting the magnitude and timing of the monsoon is difficult.

The official start of the monsoon is June 15, a date established by the National Weather Service in 2008 to reduce confusion on when the monsoon begins.

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 2009.

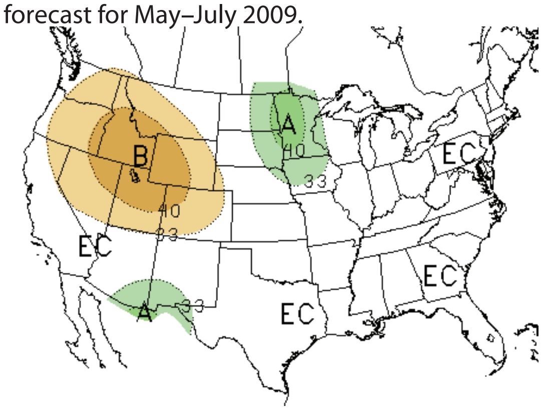


Figure 10b. Long-lead national precipitation forecast for June–August 2009.

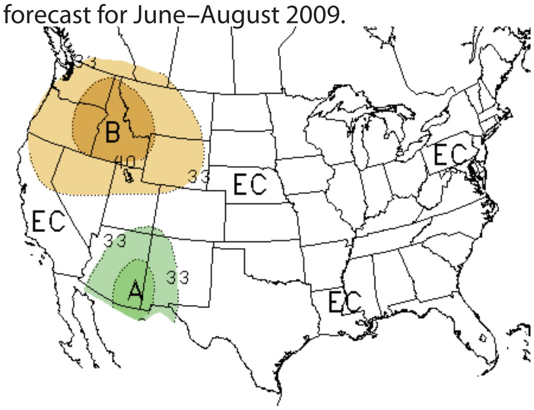


Figure 10c. Long-lead national precipitation forecast for July–September 2009.

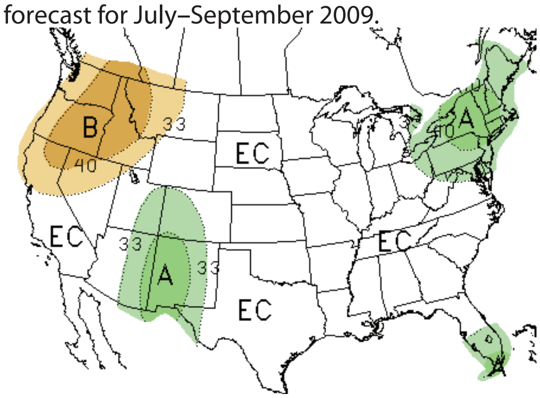
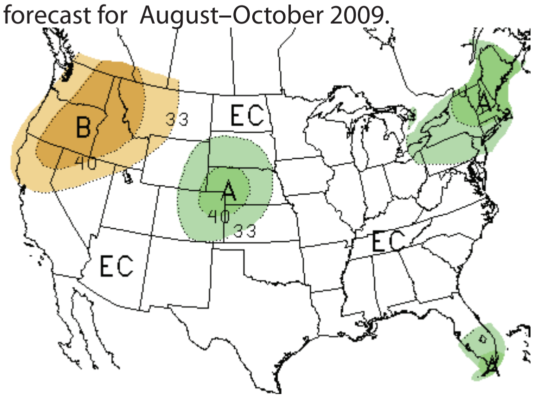


Figure 10d. Long-lead national precipitation forecast for August–October 2009.



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 July 2009)

Source: NOAA Climate Prediction Center (CPC)

The NOAA-Climate Prediction Center (NOAA-CPC) reports that drought conditions for April 16 through July will generally persist in the northern half of California, most of Nevada, parts of the Hawaiian Islands, southern Oregon and Idaho (Figure 11).

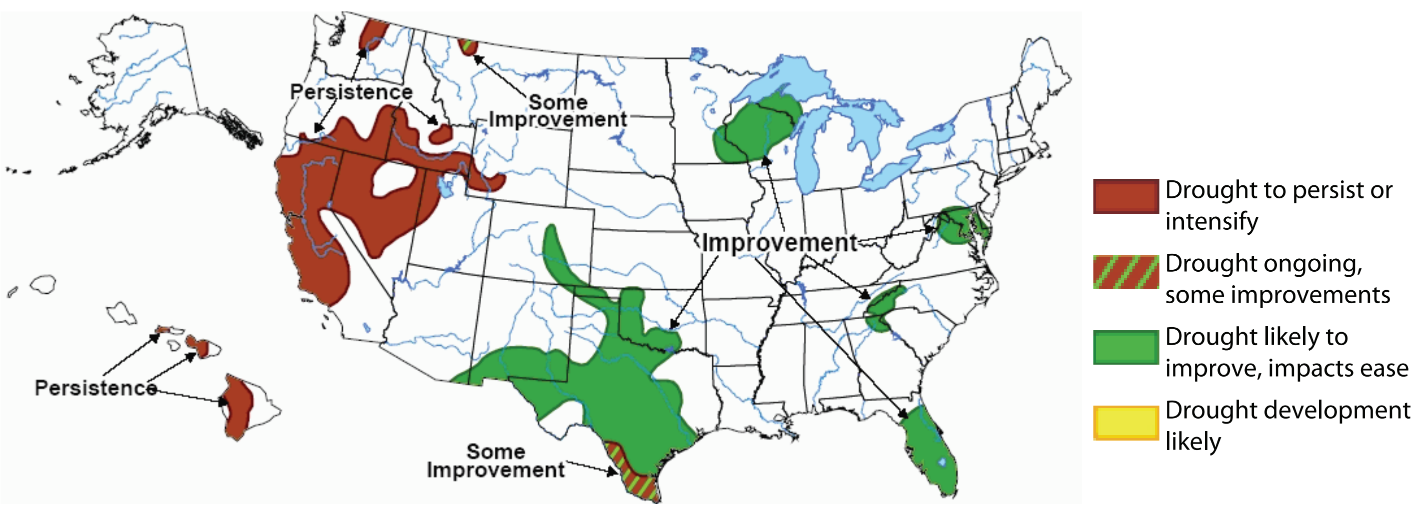
Currently, more than 50 percent of Arizona and New Mexico are experiencing some short-term drought conditions. For the remainder of April, both states likely will continue to experience dry conditions. However, by the end of July, the Seasonal Drought Outlook suggests that Arizona and New Mexico's drought-stricken areas will likely experience improvements. This outlook is aided in part by long-lead forecasts for the monsoon season, beginning in June, that suggest slightly increased chances for above-average precipitation.

The southern Plains are experiencing the nation's most serious drought conditions, but the U.S. Seasonal Drought Outlook calls from improvements by the end of July. Contributing to the improvements are forecasts for moderate to heavy rain during April 16–20 for eastern Texas and, to a lesser extent, western Oklahoma and eastern Colorado. Also, precipitation between May and July is normally heavier than during the cooler time of the year for areas to the north and west of central Texas, with monsoonal rainfall typically moving into the southern High Plains during July.

Areas in the central Rockies and the regions west to the Pacific Coast that are currently experiencing drought will likely receive very little precipitation during the second half of April. Furthermore, the West Coast states typically experience sharp drops in precipitation between May and July. As a result, drought should persist everywhere it currently exists in the central Rockies and westward.

Notes:
The delineated areas in the Seasonal Drought Outlook (Figure 11) are defined subjectively and are based on expert assessment of numerous indicators, including the official precipitation outlooks, various medium- and short-range forecasts , models such as the 6-10 day and 8-14 day forecasts, soil moisture tools, and climatology.

Figure 11. Seasonal drought outlook through July 2009 (released April 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/

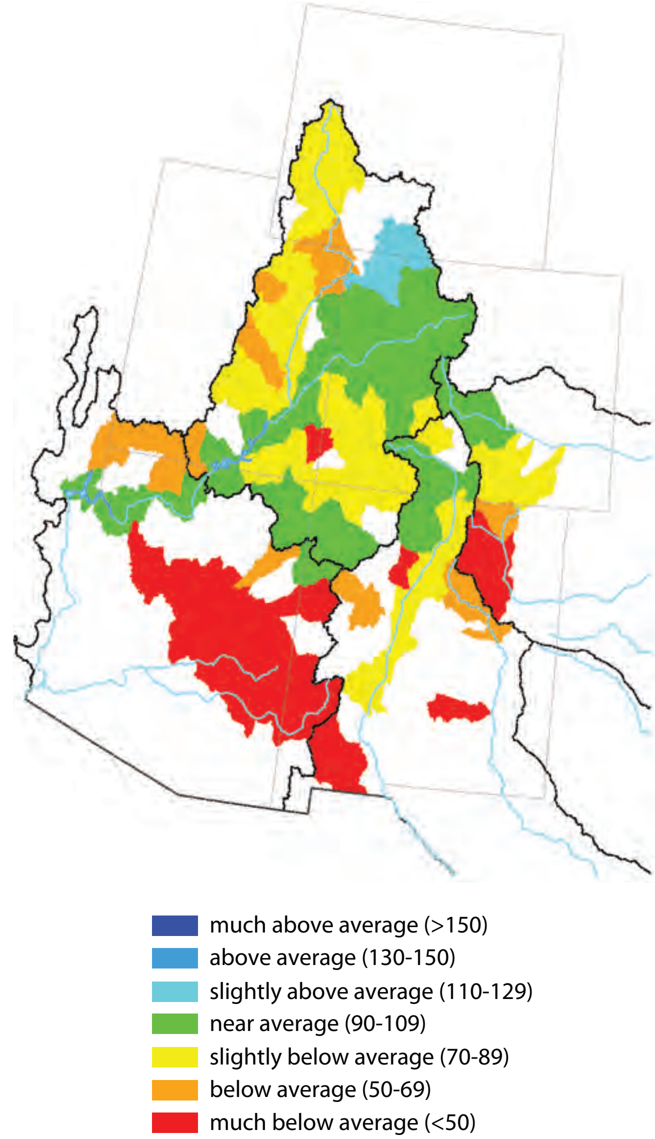
For soil moisture tools, visit:
http://www.cpc.ncep.noaa.gov/soilmst/forecasts.shtml

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

The April 1 streamflow forecast for the Southwest shows mostly below-average projected flows for basins within Arizona and New Mexico (Figure 12). Streams in northern Arizona and New Mexico, such as those originating in the Chuska Mountains, are predicted to have near-average to above-average spring streamflow. There is at least a 50 percent chance that inflow to Lake Powell will be 91 percent of the 30-year average for April–July. Streams in New Mexico's Upper Canadian and Pecos River basins are all predicted to have less than 70 percent of average streamflow.

In water-related news, On May 19, the Las Lunas silvery minnow refugium will hold a grand opening ceremony for the general public (*Valencia County News-Bulletin*, April 11). The refugium will lead efforts to protect the endangered silvery minnow, a formerly abundant species in the Rio Grande basin. The minnow was the center of considerable controversy during extremely dry conditions in 2002, when its Rio Grande habitat was threatened at the same time that municipal drinking water supplies were dropping.

Figure 12. Spring and summer streamflow forecast as of April 1, 2009 (percent of average).



Notes:
The forecast information provided in Figure 12 is updated monthly by the National Water and Climate Center, part of the U.S. Department of Agriculture's Natural Resources Conservation Service. Unless otherwise specified, all streamflow forecasts are for streamflow volumes that would occur naturally without any upstream influences, such as reservoirs and diversions. The USDA-NRCS only produces streamflow forecasts for Arizona between January and April, and for New Mexico between January and May.

The NWCC provides a range of forecasts expressed in terms of percent of average streamflow for various statistical exceedance levels. The streamflow forecast presented here is for the 50 percent exceedance level, and is referred to as the most probable streamflow. This means there is at least a 50 percent chance that streamflow will occur at the percent of average shown in Figure 12.

On the Web:
For state river basin streamflow probability charts, visit:
http://www.wcc.nrcs.usda.gov/cgibin/strm_cht.pl

For information on interpreting streamflow forecasts, visit:
http://www.wcc.nrcs.usda.gov/factpub/intrpret.html

For western U.S. water supply outlooks, visit:
http://www.wcc.nrcs.usda.gov/wsf/westwide.html

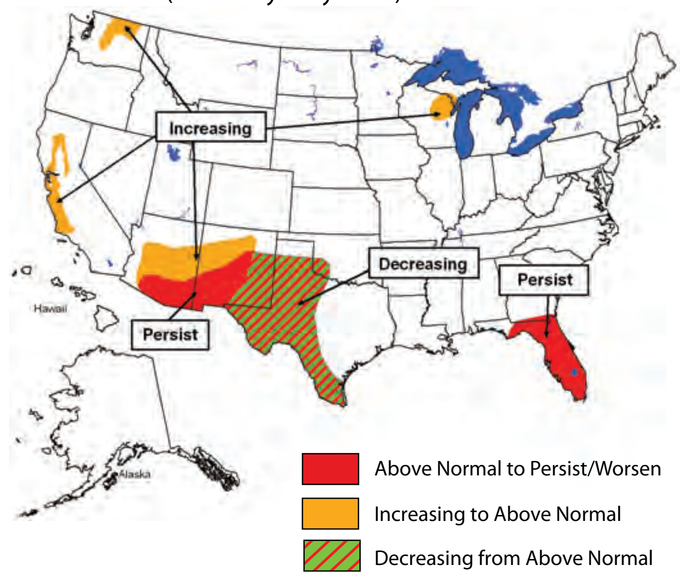
Wildland Fire Outlook

Sources: National Interagency Coordination Center, Southwest Coordination Center

The National Interagency Fire Center (NIFC) forecasted above-normal fire potential for portions of the Southwest during April. For May through July, NIFC forecasted that fire potential will likely increase or persist across many regions of the country, including parts of California and the Southwest (Figure 13). The center listed several factors that are influencing fire potential in the Southwest for the upcoming months: March was much drier than normal across Arizona and warmer than normal across much of the area, drought conditions in New Mexico are expected to persist and/or expand into eastern New Mexico, and southern Arizona will continue to experience dry conditions that will combine with carry-over fine fuels to elevate fire potential.

For May through July, most of New Mexico and much of central and eastern Arizona will be subjected to above-normal fire potential, while fire potential in northern and the far western portions of Arizona is expected to be normal. By mid to late May, fire potential will begin to decrease across portions of eastern New Mexico as precipitation and vegetation growth increases. In March, Arizona and New Mexico both experienced seven fires larger than 100 acres. Historically for March, Arizona and New Mexico have averaged one and four fires greater than 100 acres, respectively.

Figure 13. National wildland fire potential for fires greater than 100 acres (valid May–July 2009).



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.

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)

The 2008–2009 La Niña is almost officially over with ENSO-neutral conditions expected to take hold this month. The IRI reports that sea surface temperatures (SSTs) have warmed to near-average levels across much of the equatorial Pacific Ocean since last month. The above-average easterly winds along the equator typical with La Niña events weakened this past month, allowing warm water in the western Pacific to move eastward. IRI notes that this is consistent with the transition from La Niña to ENSO-neutral conditions. This transition was also detected in the Southern Oscillation Index (SOI), which reflects atmospheric circulation conditions. The SOI dropped from 1.8 in February (indicative of La Niña conditions) to 0.1 in March (representative of neutral conditions) (Figure 14a).

Forecasts produced by IRI strongly support the idea of a quick move towards ENSO-neutral conditions over the next several months, with more than a 70 percent chance of neutral conditions developing during April–June (Figure 14b). The chance of La Niña conditions redeveloping stands near 20 percent, while chances for an El Niño event are at only 2 percent. This forecast generally extends through the remainder of the year, with the chance of ENSO-neutral conditions leveling out at 60 percent (above the average historical probability) through the January–February 2010 forecast period. Forecasters at IRI note an increasing chance of El Niño conditions developing by fall 2009 but consider this a low-confidence scenario due to model sensitivities and poor model performance for this time of year. In the short term, the transition to ENSO-neutral conditions should gradually lift the impact of the recent La Niña on precipitation patterns across Arizona and New Mexico. This leaves room for weather patterns and climatic variability representing normal seasonal conditions to settle in for the spring and summer across the Southwest.

Figure 14a. The standardized values of the Southern Oscillation Index from January 1980–March 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).

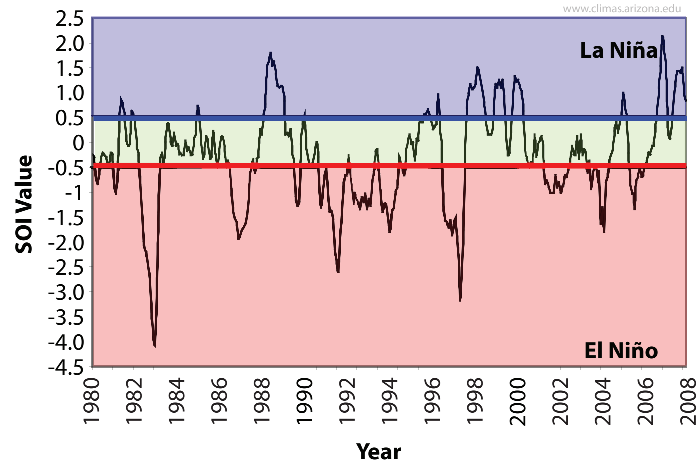
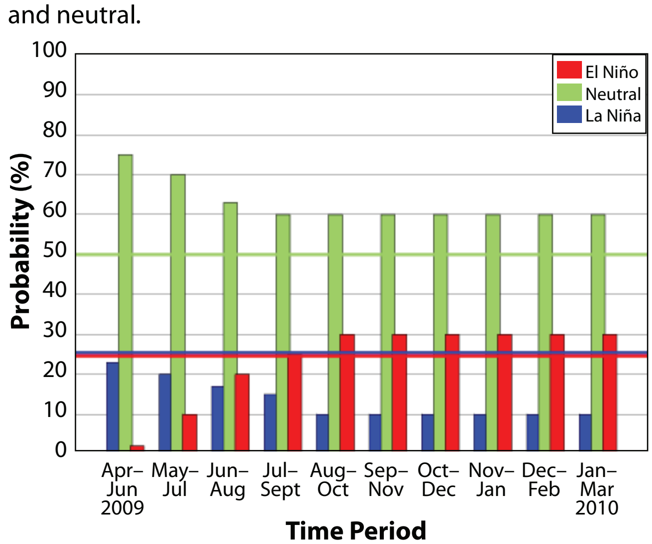


Figure 14b. IRI probabilistic ENSO forecast for El Niño 3.4 monitoring region (released April 16, 2009). Colored lines represent average historical probability of El Niño, La Niña, and neutral.



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/

Temperature Verification
(May 2009–October 2009)

Source: NOAA Climate Prediction Center (CPC)

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

The NOAA-Climate Prediction Center (NOAA-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 April for the one-, two-, three-, and four-month lead times with the actual weather give reason to believe these forecasts for Arizona. All regions in this state show a bluish color for each lead time, indicating that the NOAA-CPC forecasts historically have been more accurate than a climatological forecast (Figures 15a–d). In New Mexico, the three- and four-month forecasts have not been very accurate. Stakeholders should be leery of basing decisions on forecasts with reddish colors.

Notes:

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

The maps display the Ranked Probability Skill Score (RPSS). The more the forecasts and actual weather match, the higher the score and the bluer the color. A positive or negative 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. A score of 1 occurs if all the forecasts made match the actual conditions, while progressively negative scores occur when the forecasts increasingly don't match the actual conditions (negative scores can be smaller than -1). A score of 0 indicates that the forecasts have not been better or worse at predicting the actual conditions.

Figure 15a. Rank Probability Skill Score for May–July 2009.

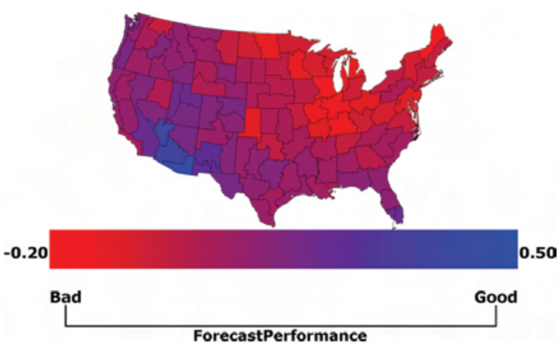


Figure 15b. Rank Probability Skill Score for June–August 2009.

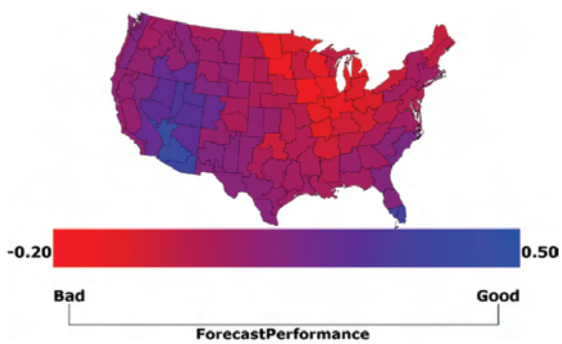


Figure 15c. Rank Probability Skill Score for July–September 2009.

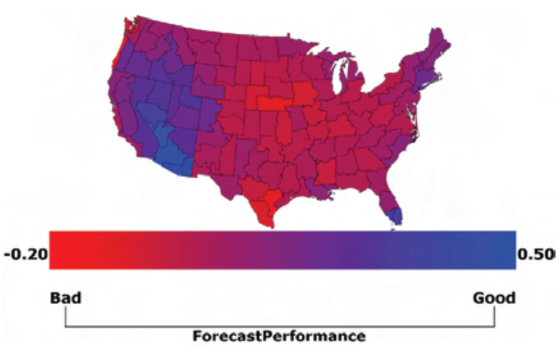
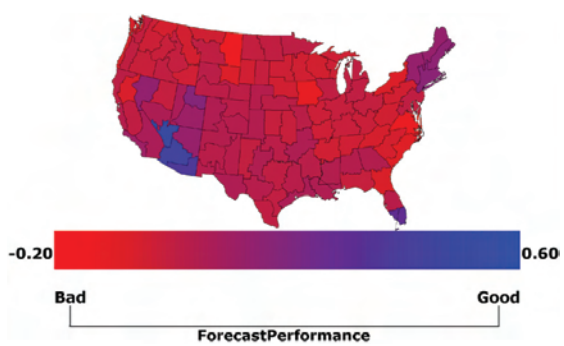


Figure 15d. Rank Probability Skill Score for August–October 2009.



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
(May 2009–October 2009)
Source: NOAA Climate Prediction Center (CPC)

The NOAA-Climate Prediction Center (NOAA-CPC) forecasts for May through October show increased chances for precipitation in Arizona and parts of New Mexico to be similar to the wettest 10 years of the 1971–2000 climatological record. Comparisons of all the forecasts issued in April for one-, two-, three-, and four-month lead times with the actual weather suggest that forecasts for some seasons have been more accurate than the climatological forecast and worse for others (Figures 16a–d). For example, the two-month lead time forecast for June–August historically has been more accurate in southern New Mexico and Arizona than in other areas (Figure 16b). However, the three-month lead time forecast for July–September has not performed as well as the climatological forecast in large portions of both states (Figure 16c). Stakeholders should be leery of basing decisions on forecasts 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 higher the score and the bluer the color. A positive or negative 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. A score of 1 occurs if all the forecasts made match the actual conditions, while progressively negative scores occur when the forecasts increasingly don't match the actual conditions (negative scores can be smaller than -1). A score of 0 indicates that the forecasts have not been better or worse at predicting the actual conditions.

Figure 16a. Rank Probability Skill Score for May–July 2009.

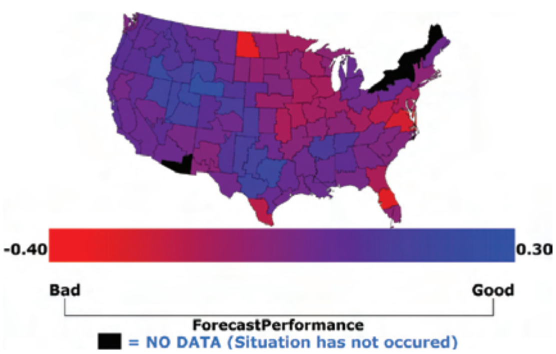


Figure 16b. Rank Probability Skill Score for June–August 2009.

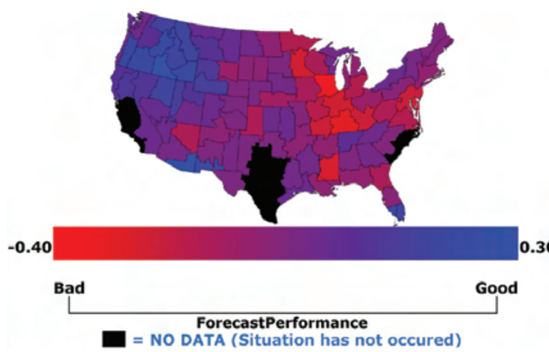


Figure 16c. Rank Probability Skill Score for July–September 2009.

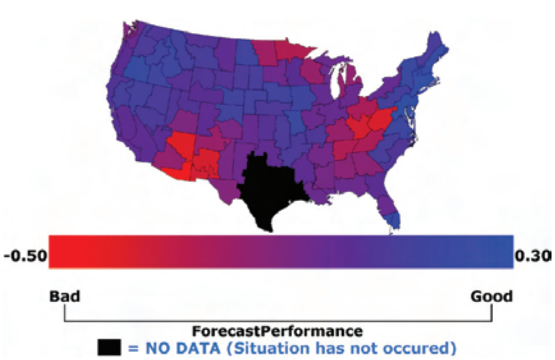
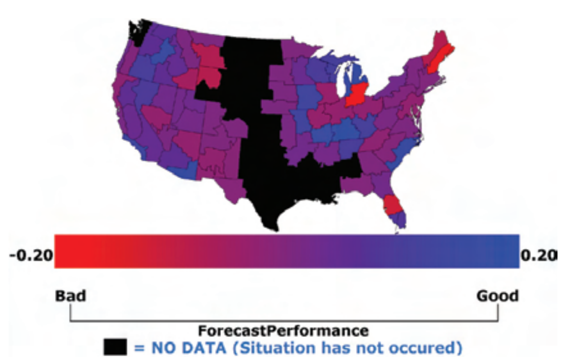


Figure 16d. Rank Probability Skill Score for August–October 2009.



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