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Southwest Climate Outlook

THE UNIVERSITY OF ARIZONA.
Arizona's First University.

Source: Zack Guido

Photo Description: A barrel cactus in bloom in early August. This photo was taken on the Finger Rock Trail in the Santa Catalina Mountains north of Tucson, Arizona.

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: knelson7@email.arizona.edu

In this issue...

August Climate Summary

Drought – Monsoon precipitation and heavy rains from Hurricane Dolly have improved drought status for most of New Mexico; nearly all of Arizona remains abnormally dry with improvement in drought status occurring only in the Southeast.

Temperature – During the past 30 days, northern and western Arizona generally were 1–4 degrees F above average. In New Mexico, the higher elevations and southwestern areas saw 1–3 degree F below-average temperatures, while the remainder of the state had 1–3 degrees F above-average temperatures.

Precipitation – The White Mountains and the far southeastern corner of Arizona have been relatively wet. Central New Mexico has received 130–300 percent of normal precipitation and the Navajo Nation area has received only 5–25 percent of average.

Monsoon – Monsoon precipitation since July 1 has been above average in most of the Southwest; southeast Arizona and most of New Mexico have receive more than 125 percent of average rainfall, with some locations receiving more than 200 percent.

ENSO – ENSO is in a neutral phase with conditions characterized by slightly above-average eastern Pacific and slightly below-average western Pacific sea surface temperatures (SSTs); the entire basin has near-average SSTs.

Climate Forecasts – Slightly above-average temperatures in Arizona and New Mexico between May and July are mostly consistent with the long-lead temperature forecast.

The Bottom Line – Monsoon storms have delivered variable but copious amounts of precipitation. In many parts of New Mexico, monsoon rain is above average. These rains have helped New Mexico experience widespread short-term drought improvements. Extremely dry conditions in northern Arizona counties have harmed many crops.

New UA Research

Rain in March and April is becoming more infrequent, lengthening the critical dry period between late winter storms and summer monsoon thunderstorms, according to new research from The University of Arizona. Stephanie McAfee, doctoral candidate in geosciences at the UA whose research is funded by CLIMAS, and Joellen Russell, an assistant professor of geosciences, compared the monthly position of the winter storm tracks, temperature and precipitation records from the western U.S., and atmospheric pressures at different altitudes for the period 1978 to 1998. The results suggest that westerly winds are shifting north, entraining several late winter storms and causing a decrease in the valuable late winter precipitation in Arizona and New Mexico.

An absence of one or two storms in March and April may not sound like much, but it has huge impacts. A longer dry period adds greater stress for plants and animals, liquefies the mountain snow that feeds many rivers in the Southwest sooner than would occur otherwise, and parches wildland fuels, elevating the risk of large fires.

McAfee's e-mail address: smcafee@email.arizona.edu

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SWCO Staff:

Mike Crimmins, *UA Extension Specialist*
Stephanie Doster, *ISPE Information Specialist*
Dan Ferguson, *CLIMAS Program Manager*
Gregg Garfin, *ISPE Deputy Director of Outreach*
Zack Guido, *CLIMAS Associate Staff Scientist*
Kristen Nelson, *ISPE Associate Editor*
Nancy J. Selover, *Arizona State Climatologist*

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Phenology, citizen science, and Dave Bertelsen

25 years of plant blooms on the Finger Rock Trail in the Santa Catalina Mountains

By Zack Guido

Dave Bertelsen carefully placed his foot on a slab of water-polished granite made slicker by overnight monsoon rains. Hiking to a perch that overlooks the Finger Rock Canyon arroyo, now rushing with coffee-colored water, he pointed to three seemingly ordinary clumps of grass. To Bertelsen, they are weeping muhly, a rare species found in the Southwest and seen only in five locations in Arizona to date. Bertelsen discovered these on one of his 1,180 round-trip hikes on the craggy Finger Rock Trail that scrambles five miles up to the summit of Mount Kimball in the Santa Catalina Mountains north of Tucson, Arizona.

Bertelsen is a self-trained botanist with perhaps the most in depth knowledge of flora in the Catalina Mountains, one of Arizona's sky islands. When it comes to the plants and animals in a 30-foot vicinity of the Finger Rock Trail, there is no question he is the world's foremost expert: he can identify 596 different plants species around the trail. Since 1983, Bertelsen has been hiking the rugged trail, logging more than 12,000 miles. On each trip, he meticulously records which plant species are in bloom.

He started recording blooming dates "out of curiosity," he said.

To scientists at The University of Arizona and at the National Phenology Network (NPN) in Tucson, Bertelsen's efforts are vital to documenting changes in the timing of life cycle events, such as first flowering date, and to observing landscape changes stemming from climate change. But to Bertelsen, the pursuit of science is trumped by his affection for the desert and particularly the Finger Rock Canyon. "I love the canyon. The diversity of flowers is astounding," Bertelsen said. "Each hike is exciting. Each time I see something new. This canyon contains more than 40 percent of the plant diversity found in the entire Catalina Mountains."

Bertelsen crouched on the granite slab with his back to the weeping muhley grass and pointed to sprouting seedlings. Although he's hesitant to identify them before they flower, Bertelsen recognizes them as smallflower halfchaff sedge. "I've only seen this plant at this location on the mountain," he said.

He then proceeded to recant the story of John Lemmon—locals named Mount Lemmon after his wife Sara. In 1881, Bertelsen said, John Lemmon and Cyrus Pringle were the first to collect *Anoda reticulata*. It was again collected in 1939 and 1940 west of Nogales. It hasn't been seen since in Arizona until Bertlesen discovered it on this trail in 2007.

Bertelsen continues with the history lesson but stops midsentence. "Oh, wow!" he said. "I haven't seen that since 2002." He squinted, visually prying apart a canopy of desert scrub and pointed to a hint of yellow. "That's Hooker's evening primrose. It's a night bloomer that is pollinated by the sphinx moth."

It's amazing that the scientific value of Bertelsen's knowledge was only recently recognized. In fact, several botanists told him that he was wasting his time. One called him the last of the 19th century botanists, a reference to people who collected plants without a purpose.

Bertelsen, however, did have a purpose. His strategic plan from the get-go included dividing the trail into five segments so that he could track the flowering of plant species at different elevations and determine the composition of vegetative communities.
Mike Crimmins, a climate science extension specialist for the UA who is involved in many outreach and com-

Figure 1. Dave Bertelsen at the Finger Rock trailhead in Tucson.

munity science projects, immediately saw the value of Bertelsen's observations. Upon meeting Bertelsen in 2005, Crimmins learned that he had amassed a continuous 20-year record of first blooming dates for hundreds of plants that spanned more than 4,000 vertical feet and many ecosystems. In 20 years, he cataloged 110,012 observations.

"I nearly fell out of my chair," Crimmins said, adding that Bertelsen unknowingly created the world's first long-term record of phenology—the study of the timing of life cycle events in plants and animals—that spans a large change in elevation. On top of that, he compiled the record with a level of detail that created a rich dataset; much remains to be learned from his work, Crimmins said.

Phenology

One purpose of phenology is to determine how plants and animals respond to climate change, said Jake Weltzin, executive director of the recently-created National Phenology Network (NPN), which is headquartered in Tucson. What happens when nectar-producing trees

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Phenology, continued

in the Northeast bloom 25 days earlier? Phenologists have answers. In the Northeast honey bees have switched their source of nectar from the tulip poplar tree to black locust tree, causing numbers of the tulip poplar to crash. Phenologists call these observations trophic mismatches and they occur when important life cycle events in plants and animals that depend on each other no longer coincide, largely the result of climate change.

Phenological changes also affect humans. The date flowers bloom, for example, is tied to allergens and infectious diseases.

Despite the consequences of phenological changes, few long records exist in the West. The most extensive and continuous record only spans 37 years. It began in 1956, when Joseph Caprio, professor at Montana State University, recruited a network of volunteers to record changes of the purple common lilac. At the height of citizen involvement, Caprio trained 2,500 people who each noted observations about lilac development and its relation to climate.

This all ended in 1993 when Caprio retired. Continuous observations of plants were then mainly left up to PhD candidates with short-lived research projects and curious citizen scientists like Dave Bertelsen. In 2004, several scientists including Mark Schwartz of the University of Wisconsin and Julio Betancourt at the U.S. Geological Survey helped create the NPN that would revitalize Caprio's lilac network and broaden phenological observations to other species.

In that dormant period preceding the creation of the NPN, phenological records collected by citizens had no outlet. Weltzin believes that many records may be collecting dust in boxes in attics.

"The number of these 'shoebox' datasets is phenomenal," says Weltzin. Since 2004, 100 datasets that range from a couple of years to several decades have made their way into NPN's database, he said.

Figure 2. A northern view of Finger Rock Canyon near the trail head.

NPN was created not only to find phenology records but also to encourage citizen involvement in phenological research and to provide opportunities for interested people to contribute to science. Currently, 800 observers are involved in NPN.

In fact, encouragement by two botanists proved to be the stimulus needed to publish Bertelsen's research. "Recognition of the value of the data from professionals was very important," said Bertelsen.

Citizen Science

Involving citizens in research is a way to engage them in the grand challenges society is facing, like global warming. It enables thousands of additional eyes to help monitor environmental changes—critical for understanding complex interactions between climate and biology—without tapping into limited scientific funds.

Bertelsen alone may have collected $1 million dollars worth of data, says Crimmins.

"If there is anytime in history when people need to pay attention it is now, because the landscape is changing so rapidly," Crimmins said.

Phenology is not the only discipline employing the help of citizens. Rainlog, for example, relies on hundreds of participants in the Southwest. Each day volunteers measure the amount of rain in a small container located on their property and report it online. This project has given scientists and citizens a closer look at rainfall patterns for two years. Scientists are crunching the data and results will likely reveal rainfall totals in neighborhoods in Tucson, Phoenix, and other participating areas that receive more monsoon rain than others.

For Crimmins, using citizens in scientific research is mutually beneficial. It helps improve the science literacy of the participants and gives scientists real data to analyze.

"In the past 10 years, science has been enamored with computer modeling which fills data gaps by creating data," Crimmins said. With projects like NPN and Rainlog, he said, thousands of people are monitoring nature and filling in

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Phenology, continued

those gaps with data from observations instead of numeric models.

"Imagine a network of people monitoring buffelgrass in their backyard," Weltzin said, referring to an invasive species that causes considerable ecological damage in the Southwest. When buffelgrass turns green—the phenological indicator that reveals that the grass can be effectively treated with herbicides—people could submit that information on-line and a computer would generate a map. Managers would then know where to spray, Weltzin said.

Changes in Finger Rock Canyon

Back on Finger Rock Trail, Bertelsen pointed to a shindagger, then a fairy duster, a sacred thornapple, and a longflower tubetongue. A Gila monster used to live over there, he said pointing at a rock.

Bertelsen pulled his hand lens from his pocket and held it over a tiny flower. He then resumed his slow walking pace, scanning 30 feet side-to-side. On each hike he surveys 1.6 million square feet, an area the size of 28 football fields, marking on his checklist which plants are in bloom. This data eventually is transferred to a computer spreadsheet.

Bertelsen is 65 years old and fit. His eyes are inset and his skin is tan—hints that he spends life outside observing the landscape. Although he's adept at spotting blooms from a distance and the plants are as familiar to him as friends, each hike is time-consuming and hard. Most guide books describe the trail as strenuous, a reputation won because of the relentless grade, numerous switchbacks, and rocky, ankle-twisting sections. Bertelsen starts at midnight and finishes no less than 12 hours later. Nothing has thwarted his dedication. Not a spiral fracture to his leg that occurred on the Finger Rock Trail and required a helicopter evacuation. Not a serious arm fracture that occurred soon after his leg accident. Not even triple by-pass heart surgery at the end of his accident-prone year.

"Curiosity is a cruel master," he said with a smile.

Bertelsen's observations of more than 20 years have revealed important dynamics between the ecology and the changing climate. With the help of Theresa Crimmins, senior research specialist for the Office of Arid Lands Studies at the UA, and Mike Crimmins, an analysis of Bertelsen's work was published early this year in the peer-reviewed journal *International Journal of Biometeorology*.

The results suggest that plants lower on the trail respond more to precipitation changes while plants high on the mountain are influenced more by temperature.

The analysis also reveals that plant habitats are moving. After logging 596 different plants dotted over 4,000 vertical feet, Bertelsen has witnessed habitat shifts, expansions, and contractions. The most visible change in species location is that currently more than 15 percent of the species bloom at elevations as much as 1,000 feet higher than in the past. As a result, the top of the mountain is becoming more diverse.

Bertelsen hypothesizes that a rise in the temperature has caused plants to move uphill to remain in the same temperature. But plants can climb the mountain only so far before they run out of earth; this is likely one cause of species contraction.

Bertelsen has also witnessed dramatic changes as a result of drought. He first started noticing effects of drought in 2002, a few years after the ongoing drought began, with the demise of 35 parched saguaros in the initial two miles of the trail where precipitation is the lowest. Between 2002 and 2007, Bertelsen tallied 88 deaths—more than in the 18 years that preceded 2002.

Higher up on the mountain in the pine forest ecosystem, 42 mature ponderosa pine trees died from 2002 to 2007, and 31 succumbed in 2002 alone. Similar to saguaros, more ponderosas died in this five-year period than in the previous 18 years combined.

Changes from drought are seen in every ecosystem in the canyon, and not just with plants. Recently, Bertelsen has been hearing less cactus wrens, curve-billed thrashers, and Gila woodpeckers, the three most common birds in the area. Since 2002, he has noted a marked decrease in the number and diversity of other animals observed in the study area.

Although the majority of plants have suffered from the drought, a few have thrived. The Mojave, spineless, and plains prickly pears, and the tanglehead grass are the only native plant species to expand since the drought began.

No Stopping

It is fair to say that Bertelsen has spent more time in Finger Rock Canyon than anyone else. And although his efforts were driven more for the love of nature than for science, his work couldn't have come at a better time. With citizens, policy makers, and scientists increasingly concerned about the effects of global warming, Bertelsen's 25 years on the trail add vital knowledge about the biosphere-atmosphere relationship.

Bertelsen believes he is seeing accelerating change in the landscape in recent years. He suggests that if the drought and increases in temperature both continue, then he will likely witness the Sonoran Desert move uphill in the lower elevations and a loss of the ponderosa pine ecosystem in the higher elevations.

When asked when he intended to stop, Bertelsen, in disbelief that the question was asked, responded:

"I have no plans to stop."

Temperature (through 8/20/08)

Source: High Plains Regional Climate Center

Throughout the water year, which began October 1, temperatures on the Colorado Plateau in Arizona and in northern and central New Mexico have averaged between 45 and 55 degrees Fahrenheit, with the highest elevations reaching 35 to 45 degrees F (Figures 1a–b). Southeastern and southwestern New Mexico and southeastern Arizona have been between 55 and 65 degrees F. Temperatures in the southwestern deserts of Arizona have averaged from 65 to 75 degrees F. In Arizona, most of these temperatures have been about 1 degree warmer than the 30-year average, but New Mexico has been 1–4 degrees F above average in the south and east and 0–2 degrees below average in the north and west portions of the state.

During the past 30 days, northern and western Arizona have been 1–4 degrees F above average; areas of the southeast have been 1 degree below or 1 degree above average (Figures 1c–d). New Mexico has had similar variability during the last 30 days of the monsoon. Southwestern temperatures have been 1 to 3 degrees below average. The rest of the state has been 1–3 degrees F above average. Much of this variability is due to the isolated nature of the monsoon activity. Areas with more thunderstorm activity tend to have cooler temperatures than the drier areas.

Figure 1a. Water year '07–'08 (through August 20, 2008) average temperature.

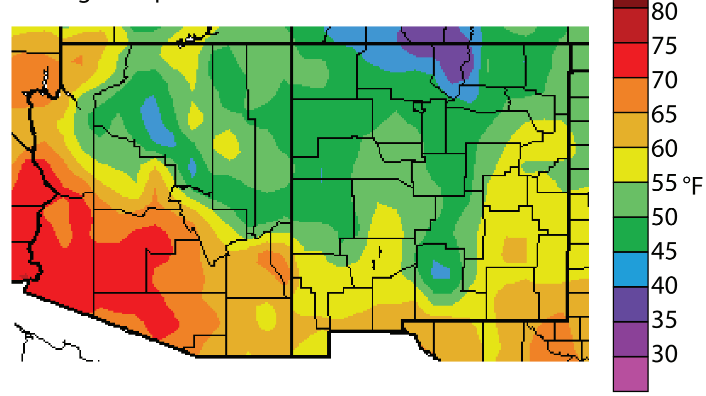


Figure 1b. Water year '07–'08 (through August 20, 2008) departure from average temperature.

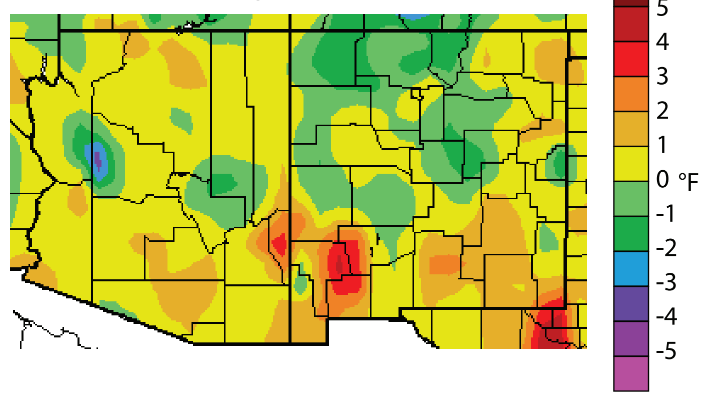


Figure 1c. Previous 30 days (July 22–August 20, 2008) departure from average temperature (interpolated).

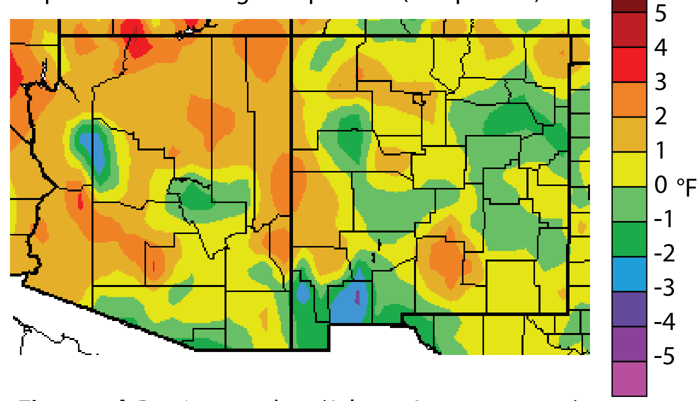
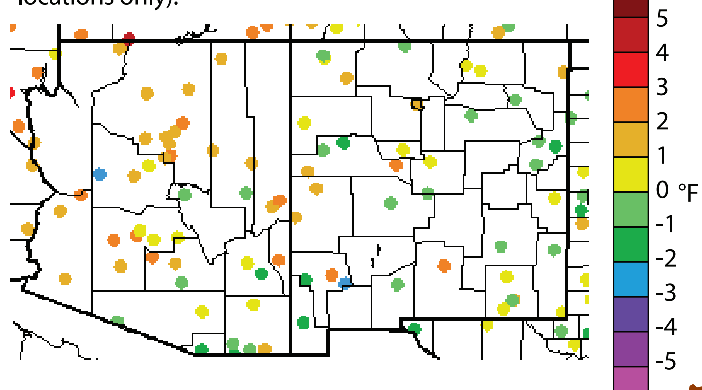


Figure 1d. Previous 30 days (July 22–August 20, 2008) departure from average temperature (data collection locations only).



Notes:

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

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

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

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

On the Web:

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

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

Precipitation (through 8/20/08)

Source: High Plains Regional Climate Center

Precipitation for the water year has been highly variable across both Arizona and New Mexico. Along the Mogollon Rim, in south-central Arizona, and in southwest and north-central New Mexico, precipitation has been between 100 and 175 percent of average (Figures 2a–b). East-central, west-central, and southeastern New Mexico, southwestern Arizona, and parts of the Colorado Plateau have received 25–70 percent of average precipitation.

In the past 30 days, central New Mexico has received above-average monsoon precipitation (130–300 percent of average), leaving northwestern and east-central New Mexico dry with 25–90 percent of average precipitation (Figures 2c–d). In Arizona, the southwestern third of the state received from less than 5 to 90 percent of average precipitation, while the north-central part of the state had 100–200 percent of average. The northeast corner, on the Navajo Nation, has largely missed monsoon precipitation, seeing from less than 5 to 25 percent of average. The White Mountains and the far southeastern corner of Arizona have been relatively wet, as the monsoonal circulation has moved storms diagonally across southeastern Arizona into New Mexico. The localized, isolated character of the convective storms is apparent from the relatively wet conditions in the northwest corner of Arizona adjacent to relatively dry conditions on the Colorado Strip and in southern Nevada.

Notes:

The water year begins on October 1 and ends on September 30 of the following year. As of October 1, 2007, we are in the 2008 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 '07–'08 (through August 20, 2008) percent of average precipitation (interpolated).

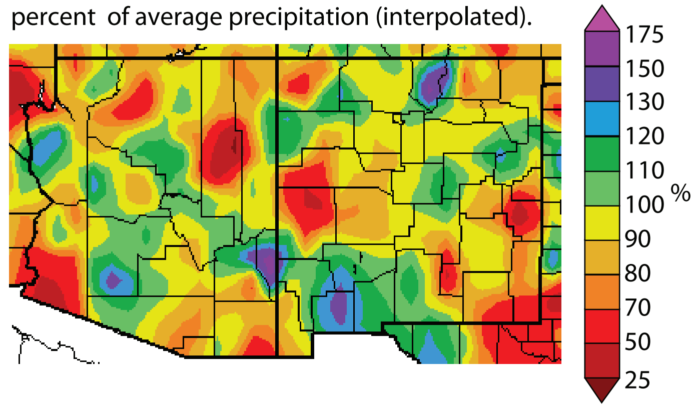


Figure 2b. Water year '07–'08 (through August 20, 2008) percent of average precipitation (data collection locations only).

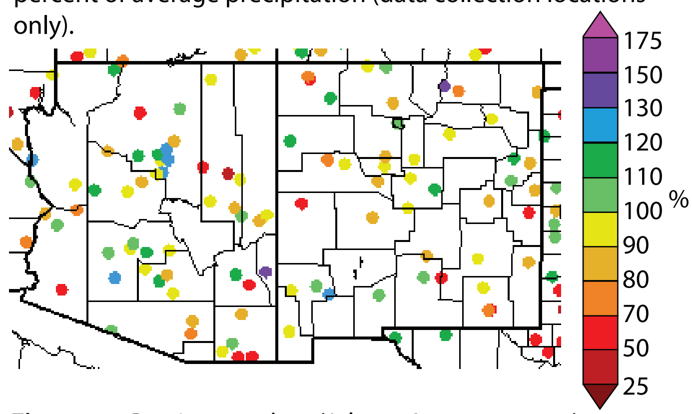


Figure 2c. Previous 30 days (July 22–August 20, 2008) percent of average precipitation (interpolated).

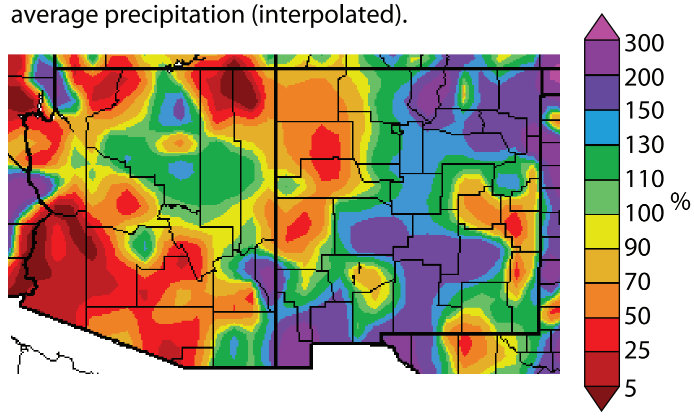
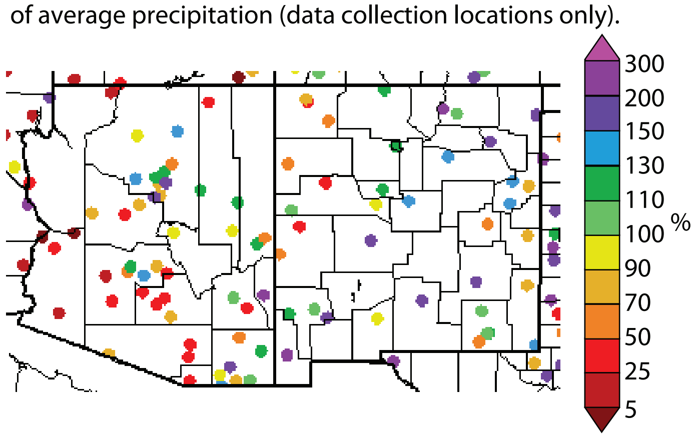


Figure 2d. Previous 30 days (July 22–August 20, 2008) percent of average precipitation (data collection locations only).



U.S. Drought Monitor

(released 8/21/08)

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

Drought severity substantially improved in New Mexico since last month, with drought lingering only in the northeastern and southeastern parts of the state (Figure 3). Arizona drought status, as measured by the U.S. Drought Monitor, changed marginally during the last month.

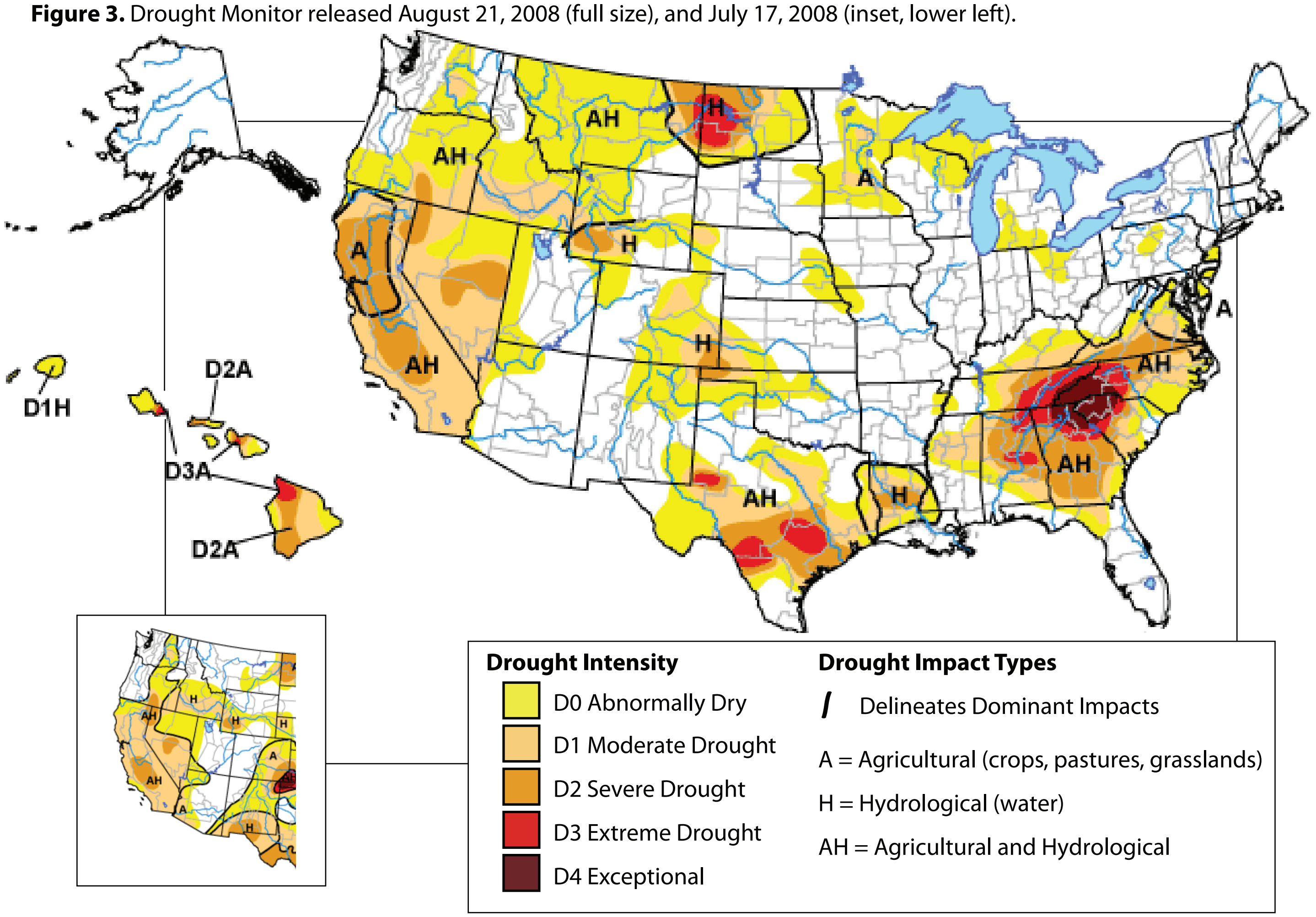
Monsoon rainfall not only ameliorated drought, but contributed to serious flooding in both Arizona and New Mexico. Tourists and Havasupai Tribe members were evacuated from Supai Canyon, a tributary to the Grand Canyon, in northwestern Arizona after several days of heavy thunderstorms flooded the area and breached a small earthen dam (Associated Press, August 18). In New Mexico, a July 27 flood in Ruidoso caused millions of dollars worth of damage. New Mexico Governor Bill Richardson declared Lincoln and Otero counties disaster areas and requested $3.6 million in state aid to help the area recover (Associated Press, August 9).

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 Eric Luebehusen, USDA.

Figure 3. Drought Monitor released August 21, 2008 (full size), and July 17, 2008 (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

(through 6/30/08)

Source: Arizona Department of Water Resources

The monsoon rains in June in southeast Arizona improved drought status from moderate to abnormally dry in parts of Santa Cruz and Pima counties (Figure 4a). However, monsoon precipitation was in short supply in the Willcox Playa and Whitewater Draw watershed in Cochise and Graham counties, resulting in a downgrade from abnormally dry to moderate drought status. Arizona is currently in the heart of the monsoon season and above-average precipitation in many locations may improve the drought status depicted in next month's Southwest Climate Outlook summaries.

According to the U.S. Department of Agriculture's Weekly Weather and Crop Bulletin, the crop moisture indices—a measure of the availability of crops' short-term water needs—in northern counties signified extremely dry conditions. Many areas in these counties experienced "ruined crops." In the southeastern counties, crop moisture indices either improved or remained the same. However, rain is still needed in these areas.

Long-term drought status has been updated (Figure 4b). This map is produced quarterly and was last updated in April. Long-term drought status incorporates conditions over the pervious 24-, 36-, and 48-month periods. The San Pedro is the only watershed that changed, moving from abnormally dry to moderate drought. The Arizona Department of Water Resources reports that the 24- and 48-month periods were wetter than average over most of the state, while the 36-month period was much drier than average across central and southern Arizona.

The next update for the long-term drought status will occur in October.

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 July 2008.

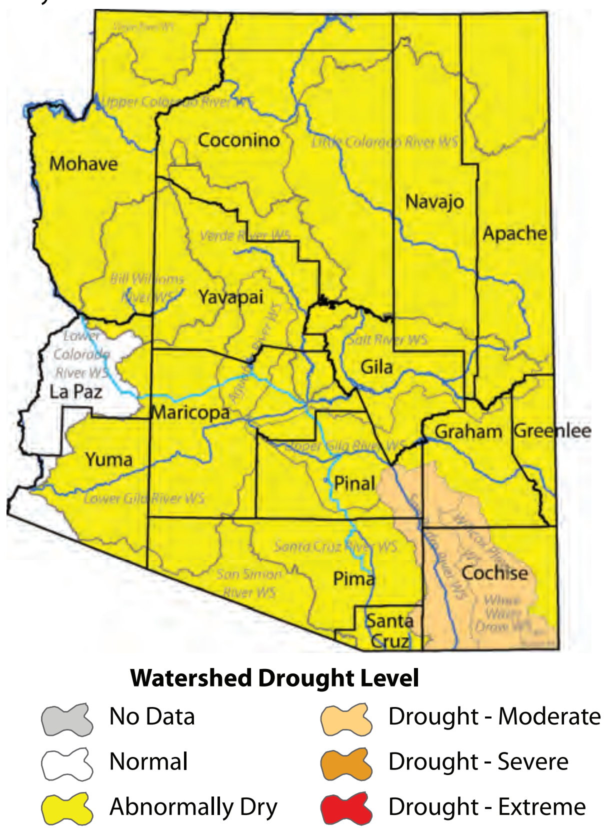
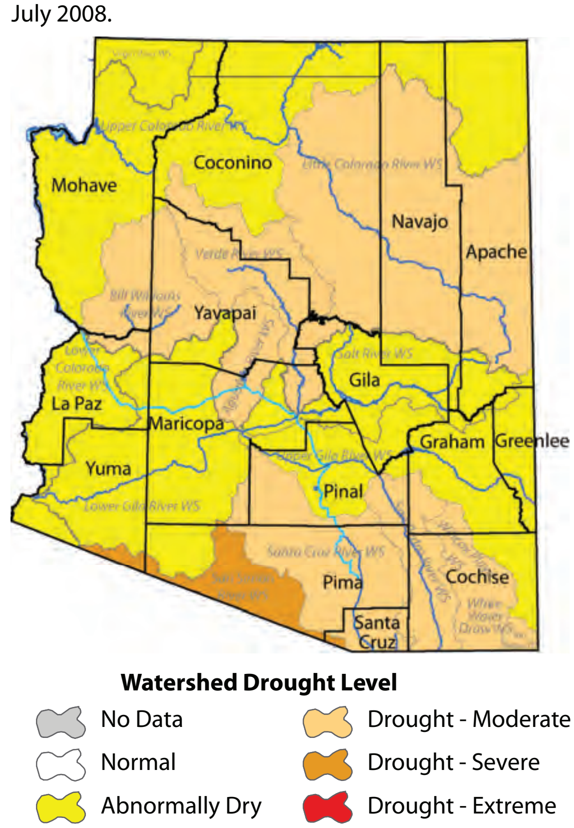


Figure 4b. Arizona long-term drought status for July 2008.



New Mexico Drought Status

(released 8/21/08)

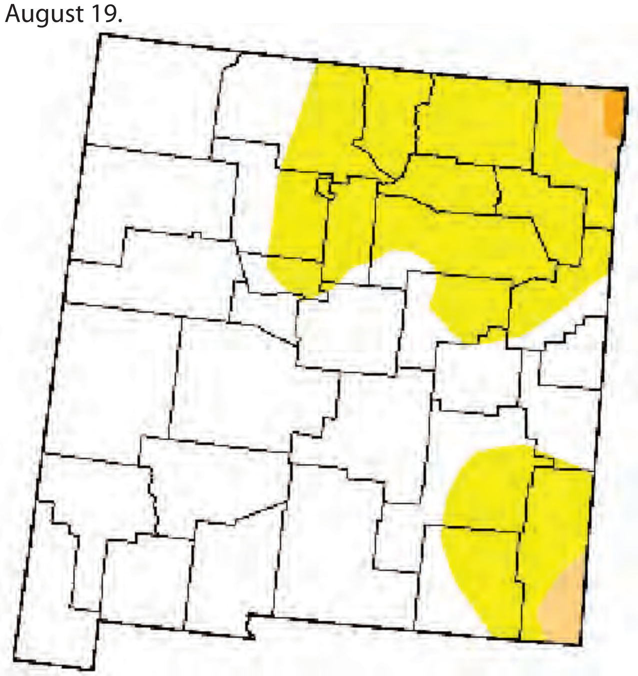
Source: New Mexico State Drought Monitoring Committee

Summer monsoon rains and heavy precipitation from the remnants of Hurricane Dolly have improved drought status for most of New Mexico. On August 19, approximately 68 percent of the state had no drought status, while only 2.5 percent of the state had moderate drought conditions or worse (Figure 5). In the previous issue of the Southwest Climate Outlook, nearly all of New Mexico except the northwest corner and a small area in the eastern part of the state was abnormally dry or worse.

According to the U.S. Department of Agriculture's Weekly Weather and Crop Bulletin the crop moisture indices—a measure of the availability of crops' short-term water needs—was predominantly adequate for crop needs.

Although the state has experienced widespread improvements in short-term drought, nine months of drought conditions have taken its toll on farmers and ranchers. Sen. Jeff Bingaman announced that 31 of the state's 33 counties have been declared drought disaster areas (*The Las Cruces Sun-News*, August 22). Farmers and ranchers in those counties are eligible for low-interest emergency loans from the U.S. Department of Agriculture's Farm Service Agency to mitigate crop losses, largely since October 2007.

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



Drought Intensity

- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional

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 7/31/08)

Source: National Water and Climate Center

Reservoir storage in Lake Powell increased by almost 2.4 million acre-feet (maf) during July 2008 (Figure 6). Lake Powell elevation is expected to be 3,630.4 feet, more than 30 feet higher than its elevation at the beginning of the water year. The measured April through July inflow at Lake Powell was 8.4 maf, which is 111 percent of average. During July, storage in the Salt, Verde, and Gila River watersheds declined slightly, though levels are substantially higher than one year ago.

In water news, the Yuma County Water Users Association is introducing carp into the California portion of the Yuma Main Canal so that the fish will eat vegetation that limits canal water capacity (*Yuma Sun*, August 9). Also, the U.S. Bureau of Reclamation has proposed new rules that require people who pump water from wells in the Colorado River floodplain to acquire water rights; scientists estimate annual losses from illegal pumping at 9,000–15,000 acre feet, enough water to satisfy the demand of Lake Havasu City (*Arizona Republic*, July 29).

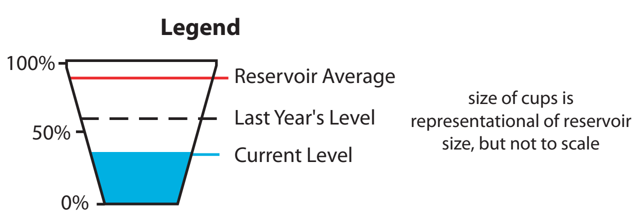
Notes:

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.

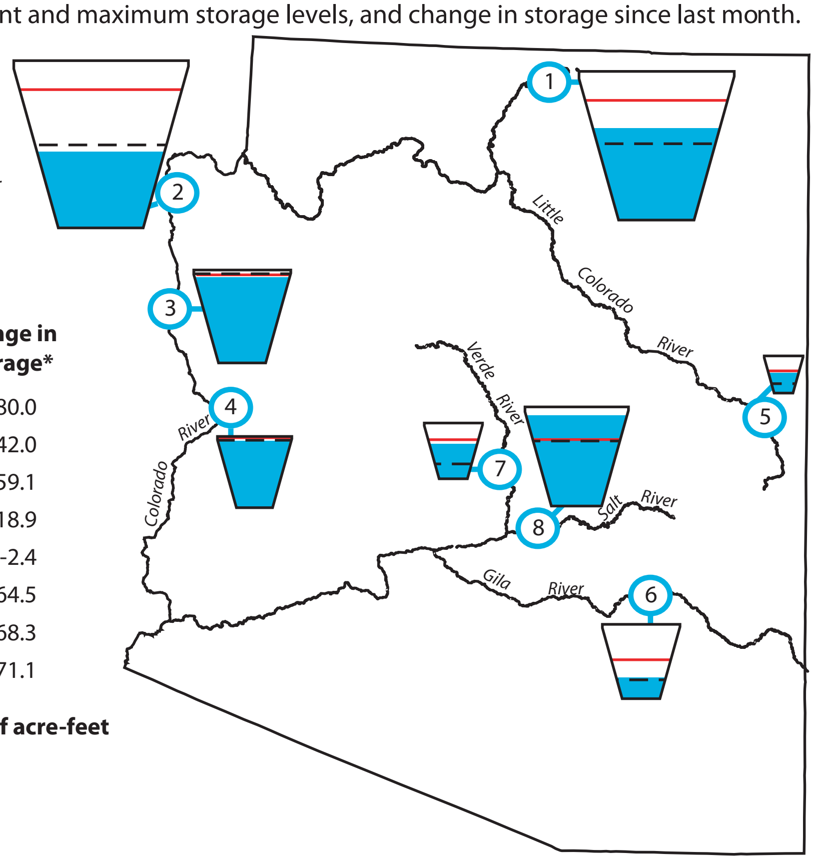
These data are based on reservoir reports updated monthly by the National Water and Climate Center of the U.S. Department of Agriculture's Natural Resource Conservation Service (NRCS). For additional information, contact Dino DeSimone, Dino.DeSimone@az.usda.gov.

Figure 6. Arizona reservoir levels for July 2008 as a percent of capacity. The map also 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	62%	15,192.0	24,322.0	2380.0
2. Lake Mead	45%	11,890.0	26,159.0	-242.0
3. Lake Mohave	92%	1,665.7	1,810.0	-59.1
4. Lake Havasu	93%	577.4	619.0	-18.9
5. Lyman Reservoir	54%	16.3	30.0	-2.4
6. San Carlos	28%	240.8	875.0	-64.5
7. Verde River System	62%	179.4	287.4	-68.3
8. Salt River System	94%	1,901.7	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 7/31/08)

Source: National Water and Climate Center

New Mexico total reservoir storage increased slightly during July. During the last month, Caballo, Brantley, Sumner, and Santa Rosa, reservoirs showed the largest relative increases. Navajo and Elephant Butte reservoir levels decreased. However, only 3 of the 13 reservoirs reviewed in the Southwest Climate Outlook show increased storage compared to one year ago.

In water news, the Navajo Nation EPA, in collaboration with the U.S. EPA and four other federal agencies, outlined a plan to clean up substantial uranium contamination from 520 identified abandoned uranium mines on Navajo Nation (*Gallup Independent*, August 14). Navajo Nation President Joe Shirley Jr. noted that between 1.3 and 2.5 million gallons of uranium-contaminated water is leaching out of a former uranium mill facility in Shiprock, New Mexico, and entering the San Juan River. Leukemia and other illnesses among the Navajo population have been connected with exposure to uranium.

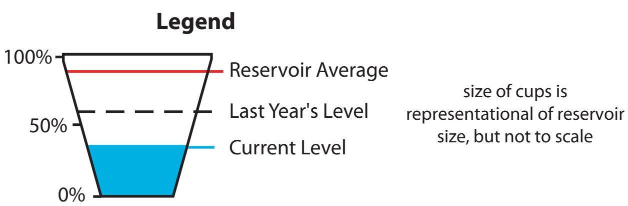
Notes:

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.

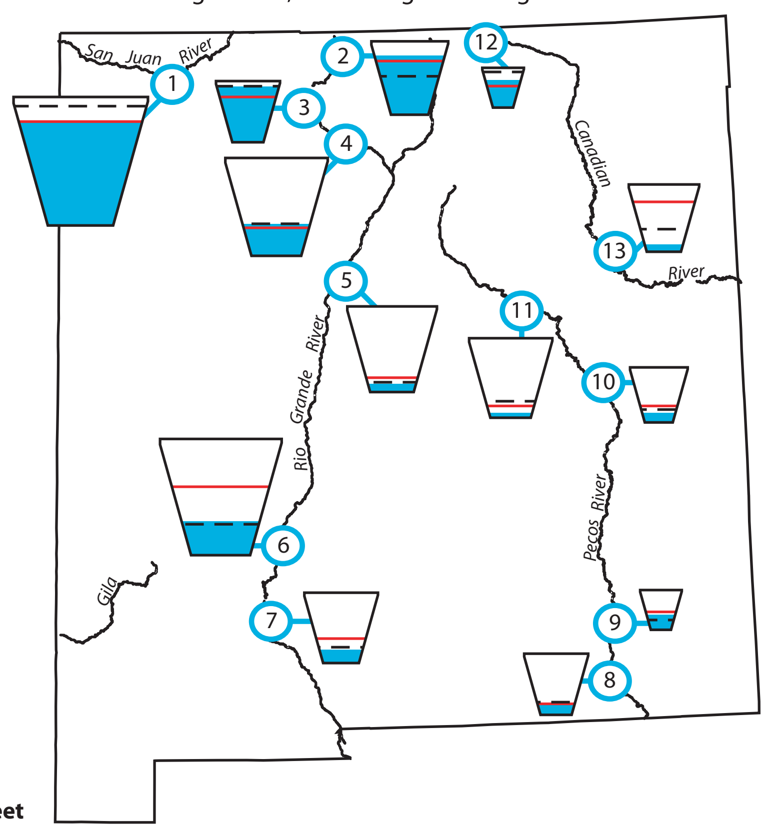
These data are based on reservoir reports updated monthly by the National Water and Climate Center of the U.S. Department of Agriculture's Natural Resource Conservation Service (NRCS). For additional information, contact Richard Armijo, Richard.Armijo@nm.usda.gov.

Figure 7. New Mexico reservoir levels for July 2008 as a percent of capacity. The map also 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	81%	1,368.7	1,696.0	-1.8
2. Heron	80%	319.3	400.0	4.6
3. El Vado	91%	177.8	195.0	0.4
4. Abiquiu	33%	180.5	554.5	4.4
5. Cochiti	10%	50.9	491.0	-0.3
6. Elephant Butte	29%	626.4	2,195.0	-1.8
7. Caballo	19%	64.3	332.0	6.5
8. Brantley	17%	25.7	147.5	7.1
9. Lake Avalon	38%	1.5	4.0	-0.1
10. Sumner	18%	18.8	102.0	3.1
11. Santa Rosa	6%	28.3	438.3	4.5
12. Costilla	69%	11.1	16.0	-2.7
13. Conchas	11%	26.7	254.2	0.7

*** thousands of acre-feet**



On the Web:

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

Southwest Fire Summary

(updated 7/21/08)

Source: Southwest Coordination Center

Copious summer precipitation throughout most of the Southwest has decreased fire potential in the Southwest. Since last month's *Southwest Climate Outlook*, wildland fire totals increased by around 35,000 acres, primarily in New Mexico. Observed fire danger in the Southwest, based on the National Fire Danger Rating System (not shown), was low for most of the region. The Arizona Strip region, near the Arizona-Nevada-Utah border, exhibited high fire danger and relatively low fuel moisture in large fuels (so-called 1,000-hour fuels).

Since the beginning of 2008, more than 4.4 million acres have burned in the United States. The year-to-date total number of burned acres is the lowest since 2003, although the total number of fires is higher than the 10-year national average.

The Arizona Department of Environmental Quality (ADEQ) has awarded a $250,000 grant to the White Mountain Apache Tribe to improve conditions in watersheds affected by the 2002 Rodeo-Chediski fire (*White Mountain Independent*, July 29). The grant will allow the tribe to plant native vegetation and install dams and dikes in areas affected by substantial post-fire erosion. Erosion protection will also further ADEQ goals of improving water quality.

Figure 8a. Year-to-date wildland fire information for Arizona and New Mexico as of August 10, 2008.

State	Human Caused Fires	Human caused acres	Lightning caused fires	Lightning caused acres	Total Fires	Total Acres
AZ	936	50,328	512	33,314	1,448	83,642
NM	610	261,912	300	114,771	910	376,683
Total	1,546	312,240	812	107,719	2,358	460,325

Figure 8b. Arizona large fire incidents as of July 21, 2008.

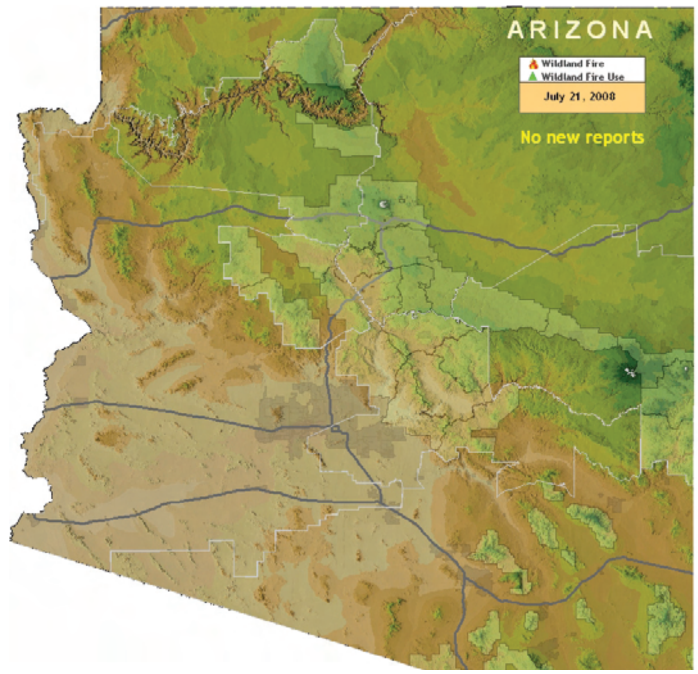
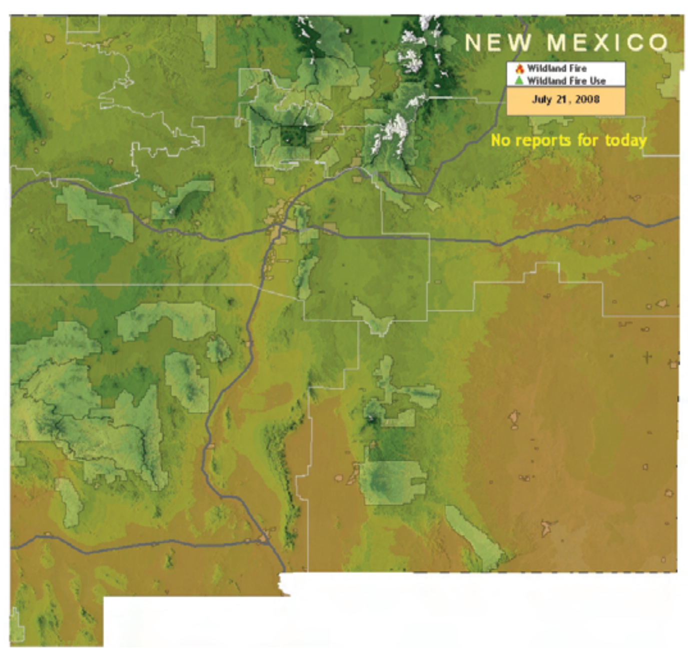


Figure 8c. New Mexico large fire incidents as of July 21, 2008.



Notes:

The fires discussed here have been reported by federal, state, or tribal agencies during 2008. The figures include information both for current fires and for fires that have been suppressed. Figure 8a shows a table of year-to-date fire information for Arizona and New Mexico. Prescribed burns are not included in these numbers. Figures 8b and 8c 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/outlooks/monthly/swa_monthly.htm

http://gacc.nifc.gov/swcc/predictive/intelligence/daily/ytd_large.htm

Monsoon Summary
(through 8/19/2008)

Source: Western Regional Climate Center

The monsoon in the Southwest has provided above-average precipitation since July 1, particularly in southeastern Arizona and most of New Mexico (Figures 9a–c). The National Weather Service in Tucson reports that since June 15, gauges in southwest Arizona have measured above-average monsoon rains in many locations. For example, 9.48 inches of rain has been measured at Nogales Airport, nearly 1.6 inches more than average.

In July, areas in Phoenix experienced nearly twice the historical average of rain, logging 3.42 inches at Sky Harbor International Airport. The pace has continued in August, with 2.3 inches of rain measured to date, about 0.5 inches above the long-term average. However, at Tucson measuring locations, August rains have tallied less than half the historical average.

There have been several breaks in monsoon precipitation in the Southwest since July 1. The longest break occurred at the end of July. During numerous consecutive days Tucson and Phoenix experienced dew points below 54 degrees, while Flagstaff and El Paso experienced similar dips.

Monsoon thunderstorms cannot take all the credit for copious rains. During the weekend of July 26, rains from Hurricane Dolly pelted many parts of Luna, Dona Ana, and Otero counties, among others in New Mexico—3.13 inches was recorded at New Mexico State University.

Due to above-normal rain in the Southwest, the U.S. Department of Agriculture reports that many areas have favorably moist conditions for crops.

Figure 9a. Total precipitation in inches July 1–August 19, 2008.

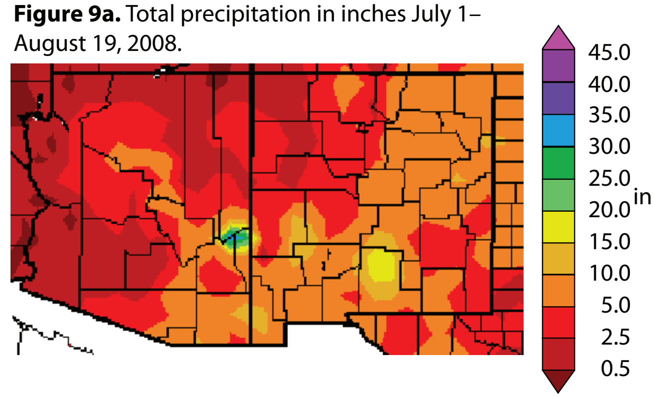


Figure 9b. Departure from average precipitation in inches July 1–August 19, 2008.

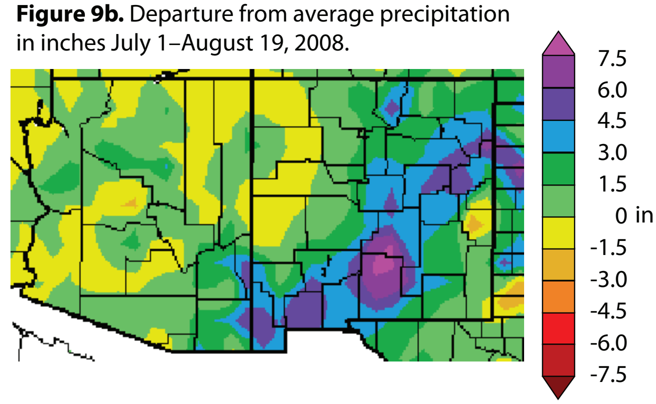
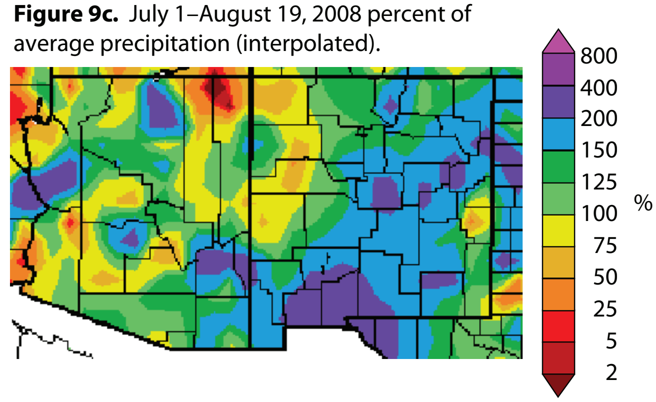


Figure 9c. July 1–August 19, 2008 percent of average precipitation (interpolated).



Notes:

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. Departure from average precipitation is calculated by subtracting the average from the current precipitation.

The continuous color maps (Figures 9a–c) 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 data used to create these maps is provisional and have not yet been subjected to rigorous quality control.

On the Web:

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

Temperature Outlook

(September 2008–February 2009)

Source: NOAA Climate Prediction Center (CPC)

The NOAA Climate Prediction Center (CPC) long-lead temperature forecasts for the Southwest show slightly increased chances of above-average temperatures for most of the region into early 2009 (Figures 10a–d). The highest chances of above-average temperatures are during the September through November season in southeastern Arizona and southwestern New Mexico. The forecasts are based primarily on long-term temperature trends. In June, atmosphere and ocean conditions in the equatorial Pacific Ocean transitioned to ENSO-neutral, which lessens predictability related to the El Niño-Southern Oscillation (ENSO) phenomenon.

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 the reliability (i.e., 'skill') of the forecast is poor; 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 September–November 2008.

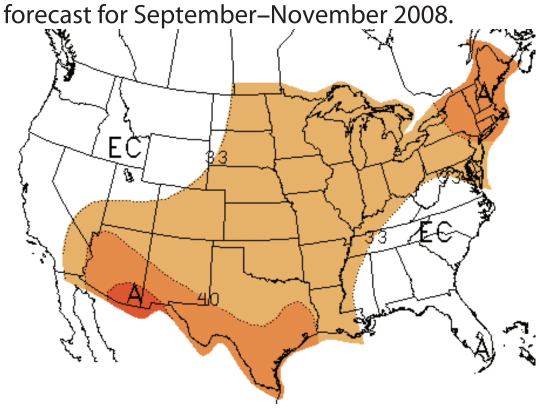


Figure 10b. Long-lead national temperature forecast for October–December 2008.

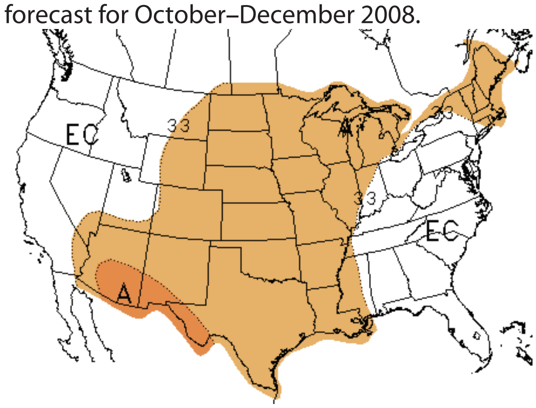


Figure 10c. Long-lead national temperature forecast for November 2008–January 2009.

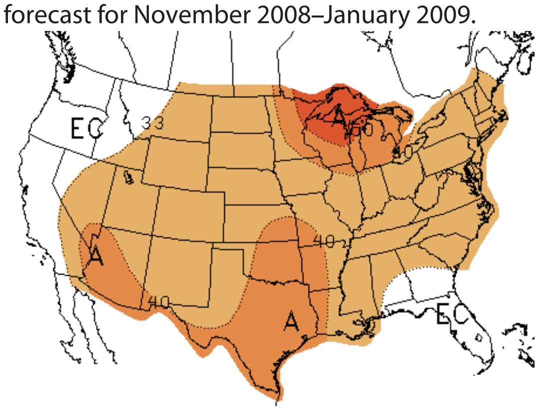
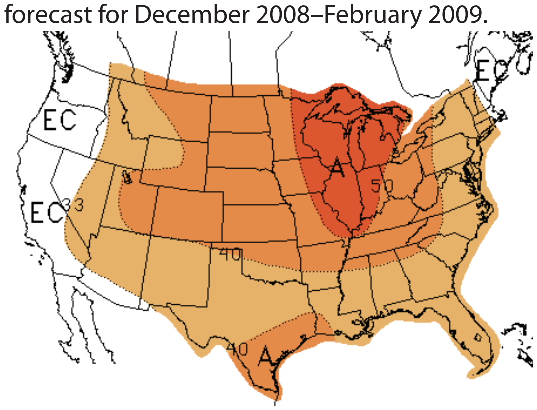


Figure 10d. Long-lead national temperature forecast for December 2008–February 2009.



A= Above

- 50.0–59.9%
- 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.html
(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

(September 2008–February 2009)

Source: NOAA Climate Prediction Center (CPC)

The NOAA Climate Prediction Center (CPC) long-lead precipitation forecasts for the Southwest show slightly increased chances of below-average precipitation for the southern half of the region during the fall and early winter (Figures 11b-d). The forecasts are based primarily on predictable precipitation trends indicated by the NOAA-CPC consolidation forecast, which combines high-accuracy statistical methods with dynamic model predictions from the NOAA Climate Forecast System model. Research by Greg Goodrich (Western Kentucky University) and Andrew Ellis (Arizona State University) shows that Arizona winter precipitation during the period of historic records is usually less than average during the ENSO-neutral phase, if the Pacific Decadal Oscillation (PDO) is in its cold phase. Earlier this year, NASA announced definitive detection of a PDO cold phase.

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 the reliability (i.e., 'skill') of the forecast is poor; 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 September–November 2008.

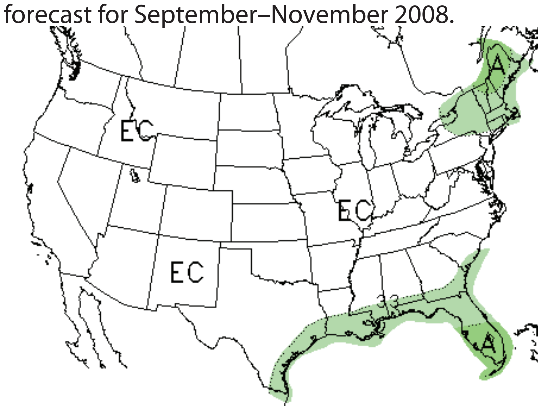


Figure 11b. Long-lead national precipitation forecast for October–December 2008.

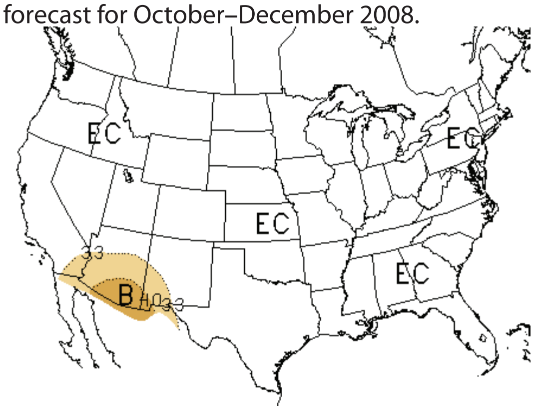


Figure 11c. Long-lead national precipitation forecast for November 2008–January 2009.

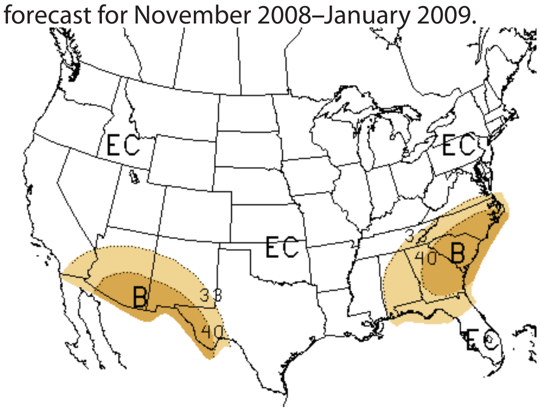
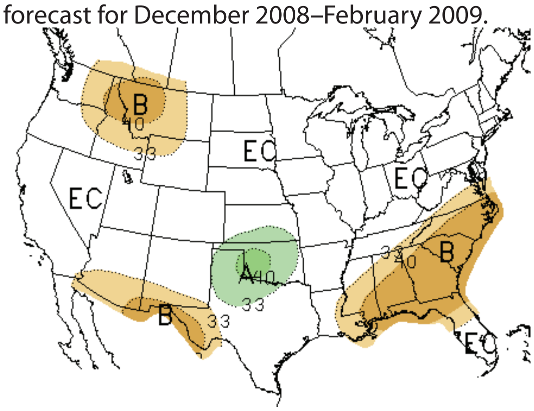


Figure 11d. Long-lead national precipitation forecast for December 2008–February 2009.



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.html
(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 November 2008)

Source: NOAA Climate Prediction Center (CPC)

Drought conditions will generally improve in Texas and many states in the Southeast, display some improvement in northern California, and persist for much of California, Nevada, and Hawaii (Figure 12). This outlook is based predominantly on subjective synthesis of recent conditions and two-week and seasonal forecasts.

Last month, the U.S. Seasonal Drought Outlook for the period through October suggested that drought will persist in southwestern Arizona. However, monsoon precipitation in the Southwest continues to be above average in many locations. As a result, there is no drought persistence and no drought development is forecasted for the August through November period for nearly all of Arizona and New Mexico.

In California, the beginning of the wet season in the fall should create some improvement in northern parts of the state. In southern California, drought persistence is predicted as precipitation typically does not significantly increase until the winter. The NOAA-Climate Prediction Center (CPC) assigns a high confidence to these forecasts.

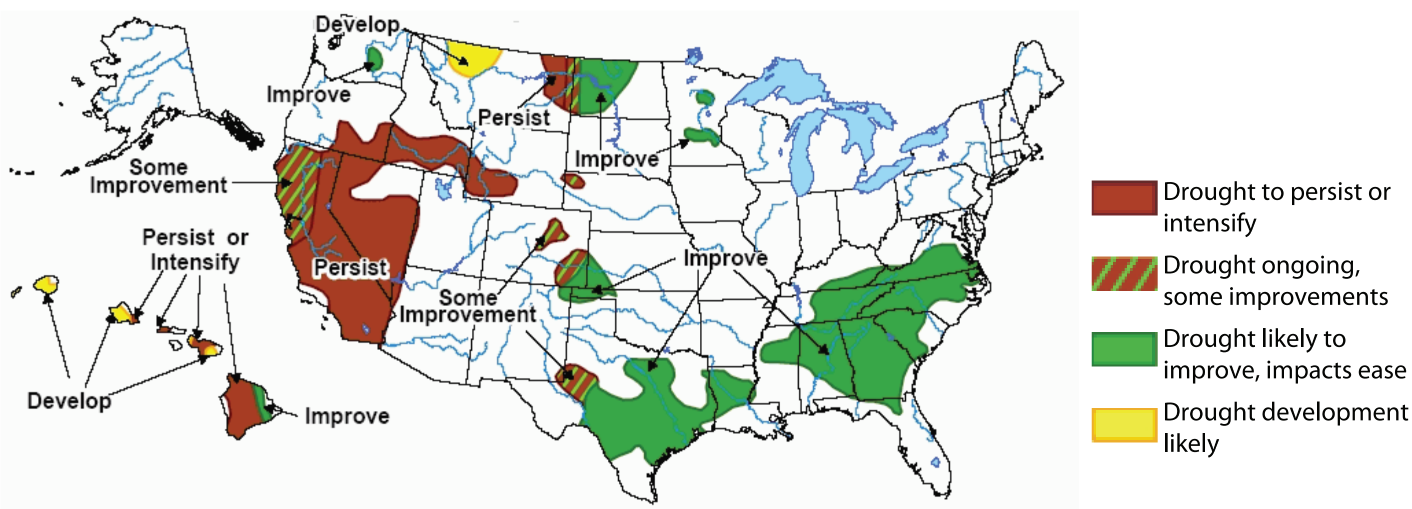
In the South, the CPC assigns moderate confidence to expected improvement s across east Texas, coastal Texas, and Louisiana. In Texas, Hurricanes Dolly and Edouard helped to reduce drought since late July. However, despite these improvements, extreme drought continues in south-central Texas.

Drought improvement in the Southeast is weighted heavily towards the precipitation from tropical storm system Fay, forecasts of above-median rainfall in the short- and medium-range, and increased odds of additional tropical storms. In this area, large reservoirs and groundwater will not show immediate improvement because they respond slowly to hydrological changes—reservoir levels should show gradual improvement as water demands decrease later in the fall. Other hydrological indicators such as small streams, soil moisture, and pasture conditions will likely show faster improvements.

Notes:

The delineated areas in the Seasonal Drought Outlook (Figure 12) are defined subjectively and are based on expert assessment of numerous indicators, including outputs of short- and long-term forecasting models.

Figure 12. Seasonal drought outlook through November 2008 (released August 21, 2008).



On the Web:

For more information, visit:
http://www.drought.gov/portal/server.pt

Wildland Fire Outlook

Sources: National Interagency Coordination Center, Southwest Coordination Center

The seasonal wildland fire outlook predicts increasing fire potential in southeastern New Mexico from September through November (Figure 13a). The outlook was released on August 1 and does not account for the 1–2 inches of rain that has fallen in southeastern New Mexico since then. Although this amount is slightly less than the year-to-date average for August, it may reduce increasing fire potential. In addition, above-average rainfall in the Mogollon Rim area of central Arizona may reduce fire potential there. The Southwest Coordination Center's monthly outlook for August (not shown) predicts normal fire potential throughout all of Arizona and New Mexico.

As of August 25, more than one large fire was reported in Oregon (10 fires), California (4 fires), Idaho (3 fires), and Washington (3 fires). Currently, 27 large fires are burning in the U.S., charring an estimated 377,719 acres. Nationally, the total number of fires in 2008 has been 110 percent of the 2003–2007 average. However, nearly 2.5 million fewer acres have burned, representing only 65 percent of the 2003–2007 average.

Notes:

The National Interagency Coordination Center at the National Interagency Fire Center produces seasonal wildland fire outlooks each month. The forecasts (Figure 13a) 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.

The Southwest Coordination Center produces monthly fuel conditions and outlooks. Fuels are any live or dead vegetation that are capable of burning during a fire. They are assigned fuel moisture values for the length of time necessary to dry. Small, thin vegetation, such as grasses and shrubs, are 1-hour and 10-hour fuels , while 1000-hour fuels are large-diameter trees. The top portion of Figure 14b indicates the current condition and amount of growth of fine (small) fuels. The lower section of the figure shows the moisture level of various live fuels as percent of average conditions.

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

Figure 13a. National wildland fire potential for fires greater than 100 acres (valid September–November 2008).

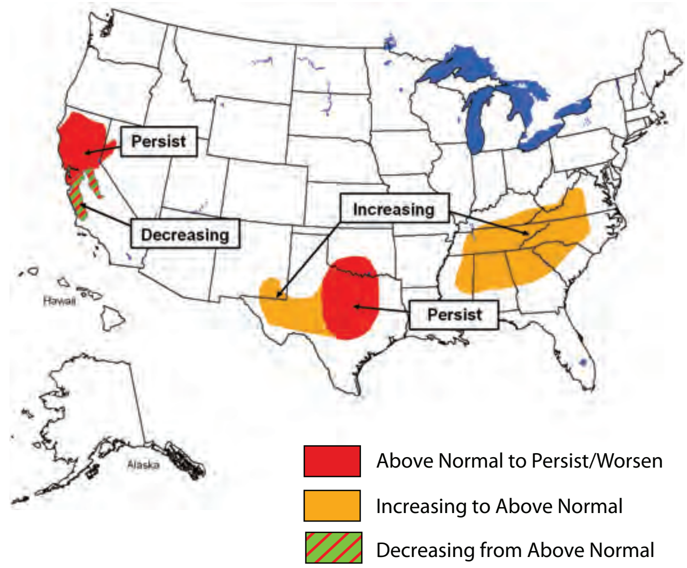


Figure 13b. Current fine fuel condition and live fuel moisture status in the Southwest as of June 1, 2008.

Current Fine Fuels						
Grass Stage	Green	X	Cured			
New Growth	Sparse		Normal		Above Normal	X

Live Fuel Moisture	Percent of Average
Arizona	
Douglas Fir	81
Juniper	65
Piñon	n/a
Ponderosa Pine	86
Sagebrush	n/a
New Mexico	
Douglas Fir	80
Juniper	79
Piñon	90
Ponderosa Pine	93
Sagebrush	184

El Niño Status and Forecast

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

Observations of sea-surface temperatures (SSTs) across the equatorial Pacific Ocean continue to indicate that the La Niña of 2007–2008 is over and ENSO-neutral conditions have returned to the basin. The NOAA Climate Prediction Center (NOAA-CPC) reports that some lingering La Niña atmospheric effects are present in the western Pacific including stronger-than-average low-level easterly winds, stronger-than-average upper-level westerly winds, and suppressed convection in the central Pacific. La Niña impacts have significantly waned in the eastern Pacific, where SSTs are now slightly above average and easterly winds are weaker than average. Southern Oscillation Index (SOI) values from July remain close to zero again this month, indicating a basin-wide return to ENSO-neutral status (Figure14a).

ENSO forecasts made by the International Research Institute for Climate and Society (IRI) continue to indicate a high probability (greater than 75 percent) of ENSO-neutral conditions continuing through the remainder of 2008 and into early 2009 (Figure 14b). The probability of La Niña conditions returning through this period remains below 5 percent, while the chance of an El Niño event hovers around 20 percent. The majority of forecast models used by IRI project that ENSO-neutral conditions will remain through spring 2009, but a few have hinted at a return to El Niño conditions over the winter. NOAA-CPC notes that there is a slight chance that an El Niño event could form later this fall or winter from warmer-than-average water building up just below the surface in the eastern Pacific. ENSO neutral conditions have limited impact on the fall and winter climate across the Southwest, while a shift to El Niño conditions can enhance precipitation across the region in the winter. Stay tuned to ENSO forecasts through the fall to monitor changing conditions.

Notes:

Figure 14a shows the standardized three month running average values of the Southern Oscillation Index (SOI) from January 1980 through July 2008. 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–July 2008. 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).

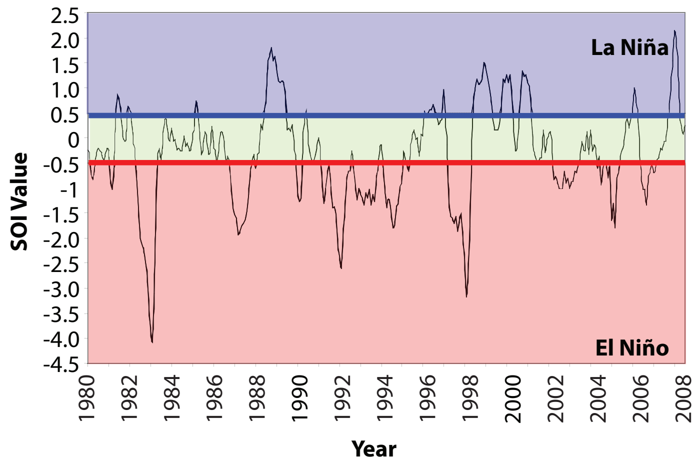
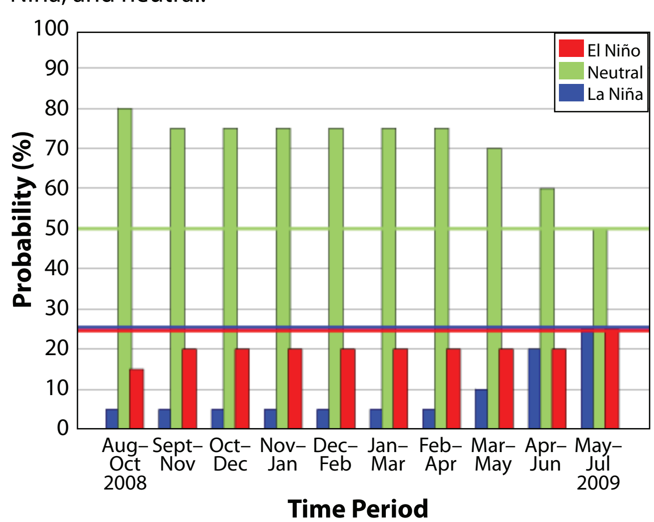


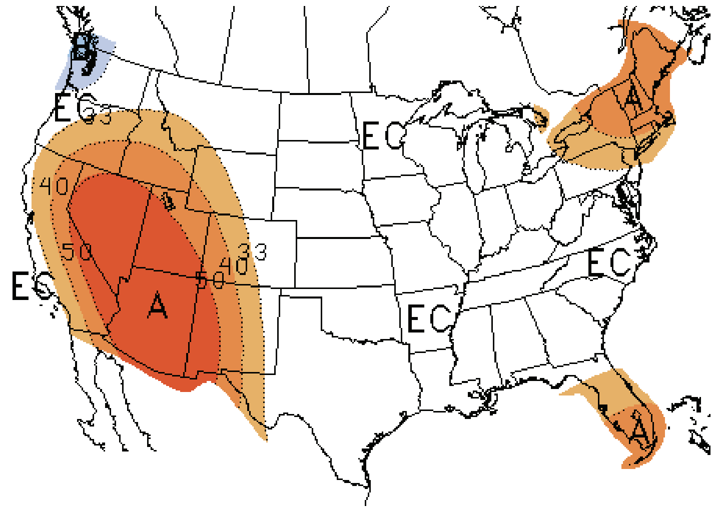
Figure 14b. IRI probabilistic ENSO forecast for El Niño 3.4 monitoring region (released August 21, 2008). Colored lines represent average historical probability of El Niño, La Niña, and neutral.



Temperature Verification
(May–July 2008)
Source: NOAA Climate Prediction Center (CPC)

The NOAA-Climate Prediction Center (CPC) seasonal temperature outlook for May–July 2008 predicted increased chances of above-average temperatures for most of the western and southern United States, including fairly high probabilities of above-average temperatures throughout Arizona and Nevada and a slight chance of below-average temperatures in western Washington (Figure 15a). The forecast also predicted warmer-than-average temperatures in New England and along the Florida peninsula. These predictions were based primarily on long-term temperature trends and, to some extent, expected effects associated with a diminishing La Niña episode in the Pacific Ocean. The overall observed pattern of temperatures from May through July was somewhat consistent with the CPC prediction, with temperatures slightly above average in much of the West, New England, and the Southeast and near average along the Washington coast (Figure 15b). The long-lead forecast predicted a fairly high chance of above-average temperatures through the Four Corners region as well as central Arizona, but the observed record revealed near-average temperatures for the period. Overall, the temperatures were mostly above average in California and Texas, mostly below average in the northern Midwest, and mostly near-average in most other parts of the U.S.

Figure 15a. Long-lead U.S. temperature forecast for May–July 2008 (issued April 2008).



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

B=Below: 33.3–39.9%; 40.0–49.9%

EC= Equal chances. No forecasted anomalies.

Notes:

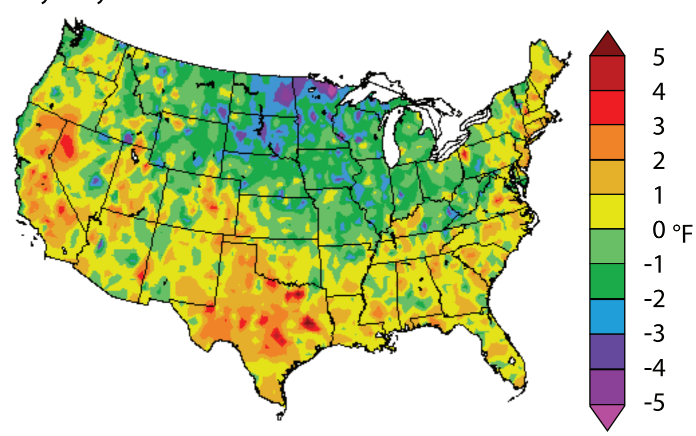
Figure 15a shows the NOAA Climate Prediction Center (CPC) temperature outlook for the months May–July 2008. This forecast was made in April 2008.

The outlook predicts 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.

Using past climate as a guide to average conditions and dividing the past record into 3 categories, there is a 33.3 percent chance of above-average, a 33.3 percent chance of average, and a 33.3 percent chance of below-average temperature. Thus, using the NOAA CPC likelihood forecast, in areas with light brown shading there is 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. Equal Chances (EC) indicates areas where reliability (i.e., the skill) of the forecast is poor and no prediction is offered.

Figure 15b shows the observed departure of temperature (degrees F) from the average for the May–July 2008 period. Care should be exercised when comparing the forecast (probability) map with the observed temperature maps. The temperature departures do not represent probability classes as in the forecast maps, so they are not strictly comparable. They do provide us with some idea of how well the forecast performed. In all of the figures on this page, the term average refers to the 1971–2000 average. This practice is standard in the field of climatology.

Figure 15b. Average temperature departure (in degrees F) for May–July 2008.



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.html

Precipitation Verification
(May–July 2008)
Source: NOAA Climate Prediction Center (CPC)

The NOAA-Climate Prediction Center (CPC) seasonal precipitation outlook for May–July 2008 predicted equal chances of near-, above-, and below-average precipitation for much of the Southwest (Figure 16a). The outlook also predicted a slightly increased chance of below-average precipitation for most of the Great Basin area as well as the Pacific Northwest. Observed precipitation revealed mostly below-average precipitation throughout the Great Basin and the Pacific Northwest (Figure 16b). A relatively early onset and somewhat wet monsoon resulted in precipitation in Arizona and New Mexico that was consistent with the long-term average. The observed precipitation record in southwest Arizona again exceeded the average, but the extremely low average precipitation in this region tends to over-emphasize one or two precipitation events in this region. Overall, the observed precipitation pattern in the Great Basin and the Pacific Northwest is close to what the NOAA-CPC outlook predicted.

Figure 16a. Long-lead U.S. precipitation forecast for May–July 2008 (issued April 2008).

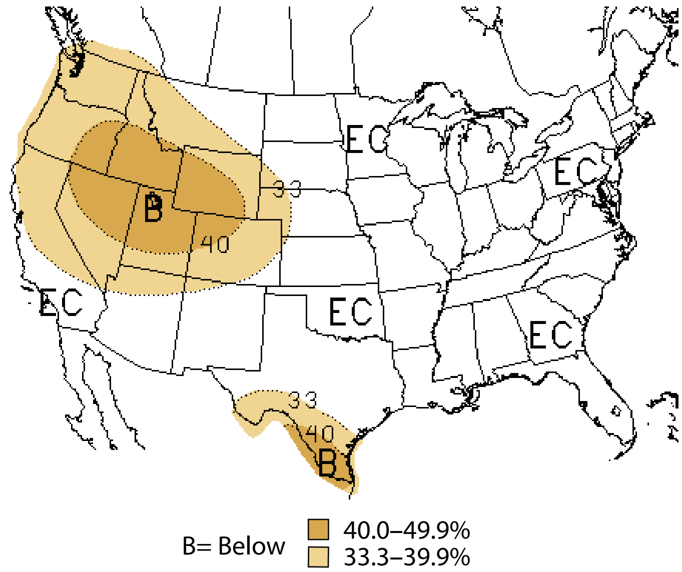
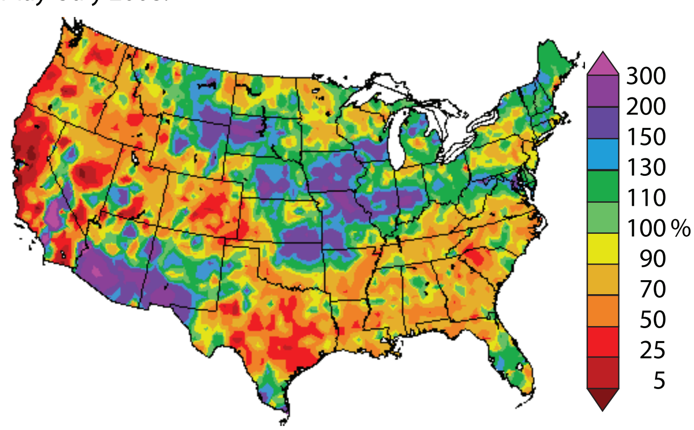


Figure 16b. Percent of average precipitation observed from May–July 2008.



Notes:
Figure 16a shows the NOAA Climate Prediction Center (CPC) precipitation outlook for the months May–July 2008. This forecast was made in April 2008.

The outlook predicts 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. Using past climate as a guide to average conditions and dividing the past record into 3 categories, there is a 33.3 percent chance of above-average, a 33.3 percent chance of average, and a 33.3 percent chance of below-average precipitation. Thus, using the NOAA CPC likelihood forecast, in areas with light brown shading there is 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. Equal Chances (EC) indicates areas where reliability (i.e., the skill) of the forecast is poor and no prediction is offered.

Figure 16b shows the observed percent of average precipitation for May–July 2008. Care should be exercised when comparing the forecast (probability) map with the observed precipitation maps. The observed precipitation amounts do not represent probability classes as in the forecast maps, so they are not strictly comparable, but they do provide us with some idea of how well the forecast performed.

In all of the figures on this page, the term average refers to the 1971–2000 average. This practice is standard in the field of climatology.

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.html