Issued: November 29, 2005

Southwest Climate Outlook

Published by the Climate Assessment for the Southwest project and the University of Arizona Cooperative Extension

November Climate Summary

Drought – Moderate drought to abnormally dry conditions persist in southeastern and northeastern Arizona, and have expanded eastward to include most of New Mexico.

- Pasture and range land conditions continue to degrade in Arizona and improve slightly in New Mexico.
- Drought conditions are much improved from last year, but the large Colorado River reservoirs and Elephant Butte Reservoir in New Mexico remain below average.

Temperature – Since the start of the water year, and over the last 30 days, temperatures over most of the Southwest have been above average.

Precipitation – Since the start of the water year, most of the Southwest has been drier than average.

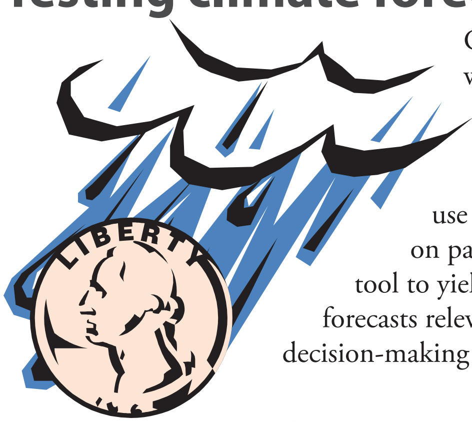
Climate Forecasts – Models indicate increased chances of above-average temperatures in the Southwest through May of 2006, but there are no forecasted precipitation anomalies for the region.

El Niño – ENSO-neutral conditions are most likely to exist during the next six to nine months.

The Bottom Line – Drought is likely to persist along some parts of the Arizona-New Mexico border. Hydrological drought continues to affect some large reservoir levels in the Southwest.

The climate products in this packet are available on the web:
http://www.ispe.arizona.edu/climas/forecasts/swoutlook.html

Testing climate forecasts



Check the climate forecast or flip a coin—which is better? Well, it depends on where, when, and what you'd like to know.

See this month's feature article, "How to use the Forecast Evaluation Tool" that begins on page 2 to find out how to use this web-based tool to yield customized comparisons of climate forecasts relevant to your interests, location, and/or decision-making needs.

See Feature Article (page 2) for more details...

In this issue:

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THE UNIVERSITY OF ARIZONA

How to use the climate Forecast Evaluation Tool

Web-based method yields quick way to test accuracy of seasonal predictions

By Melanie Lenart

"I could do better by flipping a coin." If this thought has ever crossed your mind while considering a climate forecast, you can test your theory objectively using the web-based Forecast Evaluation Tool (FET). The tool allows for an on-line examination of the successes and failures of past forecasts by climate division, season, and lead time of the forecast.

The Forecast Evaluation Tool grew under the tutelage of Holly Hartmann based on interviews she conducted with regional decision-makers for The University of Arizona's Climate Assessment for the Southwest (CLIMAS), a program funded by the National Oceanic and Atmospheric Administration (NOAA). Stakeholders revealed that they were hesitant about basing decisions on seasonal climate forecasts without knowing the track records of the forecasts.

With support from a half-dozen other agencies over the years, Hartmann and her team responded by designing the FET to provide customized comparisons of climate forecasts. Although the website continues to evolve and the tool is still under development—it is considered a "beta-test" version—the FET now can compare all forecasts made since 1994 by the National Weather Service's Climate Prediction Center (CPC), the NOAA branch that issues official government forecasts. Future plans call for similar testing of forecasts issued by other agencies, as well as testing of projections for streamflow (water transport in rivers).

This article serves as a set of easy instructions designed to guide you through the process of using the FET for the first time to check the performance of the CPC climate forecasts you consider most relevant.

Getting started

Go to the website http://fet.hwr.arizona.edu/ForecastEvaluationTool/ (Figure 1). Register for the confidential service by providing your name, organization, and email address and choosing a login name and password. After you submit your registration information, you should be able to sign in with no wait. In time, users will have the option to save their evaluation work and other climate information for future reference. Use of the FET is free of charge and registration information will not be shared with any other organization.

Download Java

Many new computers already have Java installed. If yours doesn't, Java offers a free download of the Sun Java Runtime Environment program (237 kilobytes) needed to show the results of the evaluations. You can access a link to the Java website directly from the FET website. Choose the correct program for your system and follow the installation instructions. Once the program is installed, return to the FET website.

Interpreting climate forecasts tutorial

An optional tutorial introduces users to the concepts and terminology of CPC forecasts. For instance, the tutorial brings home the important point that an Equal Chances or "EC" forecast is tantamount to no forecast at all. To make sure you're interpreting CPC forecasts properly, you can take the five-question self-test at the end. As soon as you submit your answers, you'll see your score as well as the correct answers.

Seasonal climate forecasts use a tercile approach. They consider the probability that climate conditions will fall into one of three categories: above-average, near-average, or below-average. Average is relative to forecasts made during a 30-year period—from 1971 through 2000.

Each of the 30 baseline seasons (or years) is divided equally into these three categories, with 33 percent labeled above-average, 33 percent called near-average, and 33 percent considered below-average. For example, a forecast that calls for a 40 percent probability of above-average temperature is less certain than a forecast that calls for a 70 percent probability of above-average temperatures. In both cases the projection is

continued on page 3

Figure 1. FET homepage (http://fet.hwr.arizona.edu/ForecastEvaluationTool).

Forecast Evaluation Tool, continued

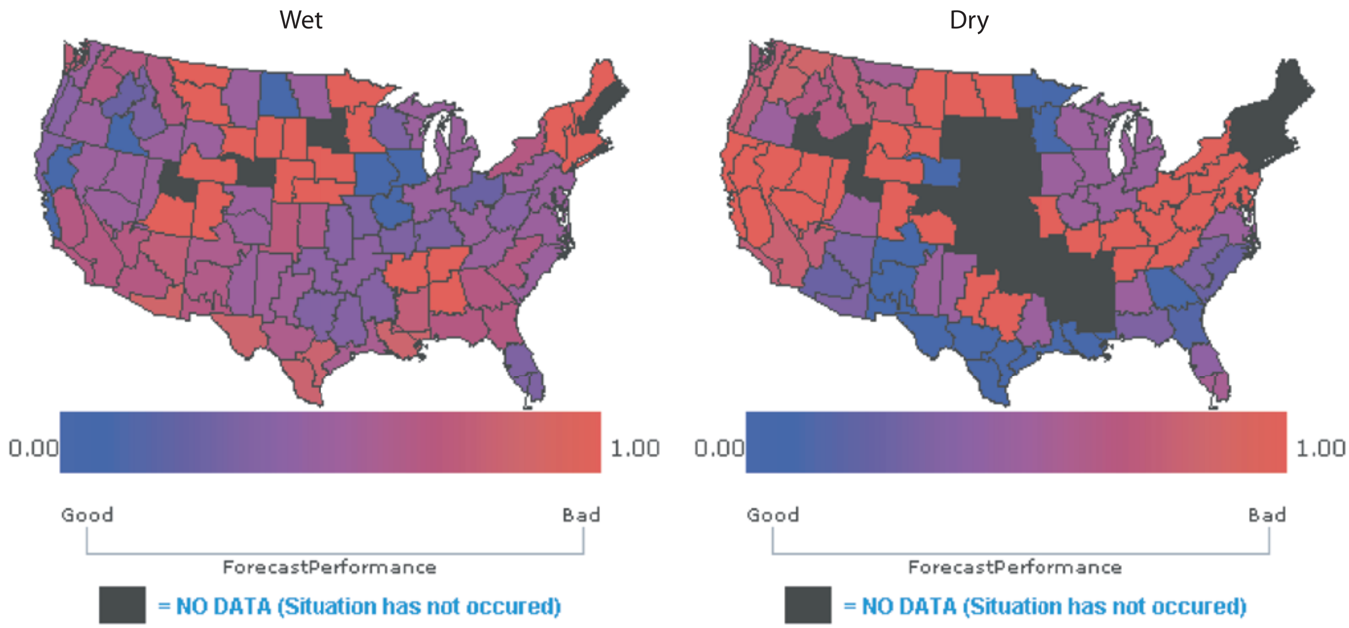

Figure 2. An example result of the Forecast Evaluation Tool. The False Alarm Rate results for climate forecasts issued in November for the December—February season. New Mexico's winter forecasts tended to be more successful than Arizona's, especially for predicting drier than average conditions (map at right). For example, the 0 scores for the three divisions in western New Mexico indicate that every forecast for dry conditions in the last decade panned out. Forecasts for wet winters in the Southwest only came to pass about half the time or less (map at left).

for temperatures to fall into the above-average tercile as compared to the forecasts made from 1971 through 2000.

White space on the map indicates Equal Chances (EC) of falling into any of the three terciles (i.e., no forecast). Only rarely does the CPC issue a forecast predicting near-average temperatures, indicated by gray shading.

Climate forecast performance

On the FET home page, you'll also see options to "Explore the Forecasts," to consider "How do the forecasts relate to my specific situation?" and to evaluate "Forecast Performance." Select "Forecast Performance" to follow the example here.

This is where you can test and compare how CPC forecasts have performed in the past, based on the forecasts issued since 1994. Here we take a step-by-step approach to testing a seasonal forecast's success:

1. The "National Weather Service Climate Prediction Center" option is automatically selected, so there's no need to do anything. (In the future, other options will become available.)

2. Select NWS CPC seasonal climate outlooks (contiguous states).

3. Select precipitation.

4. Select a forecast season, in groups of three months, by sliding the shaded box with your cursor and then clicking on it. The months are listed by their first initial only. Choose DJF to get the three-month seasonal outlook for December, January, and February. The selected grouping will show up below the shaded area as DJF. (If you want to do more than one three-month period, click your mouse upon each selection and you'll see the selected months listed below.)

5. Select the month or months during which the forecast was issued. Click in the boxes for each year you want. We'll select N (November) for each available year (1994–2004). The three-month seasonal forecasts are issued up to a year in advance and updated every month.

6. You now have the opportunity to select the type of statistical test you'd like to apply to the forecasts. Select the "False Alarm Rate" option. Brief descriptions of the other options (e.g., Probability of Detection, Brier Score) are included at the end of this article.

7. Once you have made your choices, hit "Submit" to launch the program. When the results appear, read the box at the top under "You Chose" to make sure the computer accurately recognized all your choices. (For example, if you did not click on your season selection, the default "All Seasons" will appear.)

8. The results will include national maps color-coded by division and a color bar below that explains the legend (Figure 2). For these comparisons, the 344 NOAA climate divisions have been grouped into

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Forecast Evaluation Tool, continued

102 larger divisions. New Mexico and Arizona each have four divisions under this system, with one or two divisions that overlap other states. You can see the actual value for a climate division by holding your cursor over it.

Frequency of Forecast Results
Regardless of which category you select, you will first see a map indicating the Frequency of Forecast Results. This shows how often a forecast was actually made about the season of interest by climate division. A value of 0.322 means a forecast covered some or all of the division about 32.3 percent of the time since 1994, when forecasts were finally available more than one month ahead. Scroll down to see the results you were seeking.

False Alarm Rate
This comparison considers how often the projected forecast turns out to be wrong, using the category that was predicted to be most likely. To convert the resulting climate division score into a percentage, just multiply the value by 100. So if forecasters called for wet conditions three times, but they only occurred twice, the false alarm rate would be 0.333 or 33 percent. Note that, in this case, low scores are good. To consider how often an issued forecast was accurate, just subtract the False Alarm Rate score from 1 (or the percentage from 100). In this theoretical example, the forecast was accurate 66 percent of the time. In the actual example tested here, scores ranged from 0.5 to 0.857 for "wet" conditions and from 0 to 0.75 for "dry" conditions (Figure 2). Water managers have indicated they find the False Alarm Rate particularly relevant.

Show data behind the map
If you want to see the forecasts that were considered for the evaluation, click on a climate division of interest and then click on the "Show the Data Behind the Map" option. First you'll see a description of how to interpret bubble plots, including a sample bubble plot. Then you'll see the data used for the climate division of interest for the season(s) and years indicated.

Besides the False Alarm Rate, there are a number of other options available for evaluating forecasts. To try other techniques, return to the Climate Forecast Performance page. (If you can't find it, return to the FET homepage and select "Forecast Performance.")

Modified Heidke Score
This selection is intended for use by the National Weather Service (NWS) forecasters who have historically used this approach to evaluate forecasts. It is included on the FET site because NWS forecasters receive instruction in use of this tool as part of their ongoing climate training courses, explained NWS Climate Services Chief Robert Livezey. However, the other methods provided are better for those not familiar with the Heidke system, he said.

Probability of Detection
This analysis indicates how often a forecast was made for non-average conditions compared to the total number of times it actually occurred. Your results will include separate maps for forecasts of above-average events (wet or warm) versus below-average events (dry or cool). To convert the resulting climate division score into a percentage, just multiply the resulting value by 100. A score of 0.346 for detecting wet conditions for the selected season means the CPC issued a forecast calling for above-average precipitation in about 34.6 percent of the cases in which precipitation tallies registered as above-average. Emergency managers have indicated they find these scores useful.

Ranked Probability and Brier scores
While the Brier score differentiates categories into wet and dry (or warm and cool), the Ranked Probability score provides one lumped result for both conditions. Other than that, they have similar features. Both scores take into consideration the strength of the issued forecast. So, if above-average conditions prevail as the CPC had predicted, a forecast issued with a 70 percent probability gets a higher score than one issued with a 40 percent probability. Similarly, the 70 percent probability forecast takes a bigger penalty than the 40 percent probability if conditions turn out to be average—and an even bigger hit if conditions turn out to be below-average.

The Brier and Ranked Probability skill scores represent the proportion of time above and beyond what would be expected by chance (33 percent). That's partly why a climate division with a Probability of Detection score of 0.517 can translate into a Brier skill score of 0.086. This also explains why some of the skill scores turn up negative, indicating the viewer theoretically could have done better just by flipping a three-sided coin.

Customize your options
Now you have the know-how to consider how forecasts fare during a variety of seasons with a number of different lead times, using evaluation approaches that suit your needs. The website has many other features to explore on your own.

Want to know more?
If you have any questions about how the website works, you can send an email to hydis_team@hwr.arizona.edu.

Support for development and implementation of the Forecast Evaluation Tool came from the National Oceanic and Atmospheric Administration, the NOAA-funded Climate Assessment for the Southwest (CLIMAS) and GEWEX Americas Prediction Project (GAPP) programs, the National Aeronautical and Space Administration, NASA's Hydrologic Data and Information System (HyDIS), EOS-DIS Synergy programs, the National Science Foundation, and the NSF-funded Semi-Arid Hydrology and Riparian Area (SAHRA) Science and Technology Center.

Temperature (through 11/16/05)

Source: High Plains Regional Climate Center

Most of the Southwest has experienced above-average temperatures since the start of the water year two months ago (Figures 1a–b). Most of the region has been at least 1–4 degrees Fahrenheit (F) warmer than average, except for parts of east-central New Mexico and west-central Arizona. Parts of far northern and far southwestern New Mexico and parts of southeastern Arizona have been even warmer, with temperature anomalies up to 5 degrees F above average. A small part of west-central Arizona has been 1–2 degrees F cooler than average. The warmest temperatures continue to be in southwestern Arizona. Figures 1c–d show that the last 30 days have been 2–8 degrees F warmer than average, except for the small cooler-than-average area in west-central Arizona.

The Tucson National Weather Service reports that the average temperature of 72.7 degrees F for the month of October was 2.2 degrees F above average, and ranks as the 17th warmest October on record. For the calendar year, 2005 ranks as the seventh warmest year on record (tied with 1996), with an average yearly temperature of 73.2 degrees F.

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/products/current.html

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

Figure 1a. Water year '05–'06 (through November 16, 2005) average temperature.

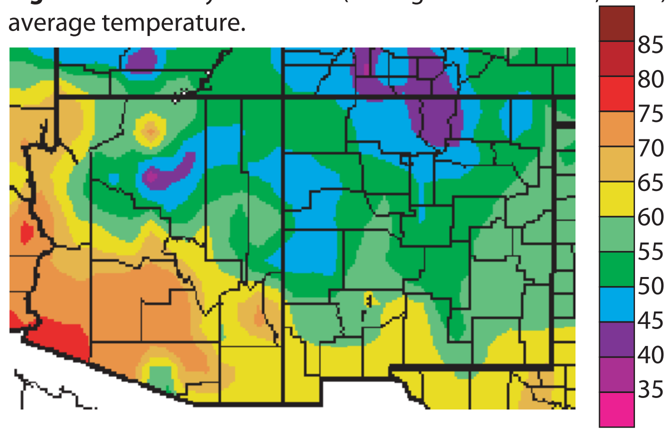


Figure 1b. Water year '05–'06 (through November 16, 2005) departure from average temperature.

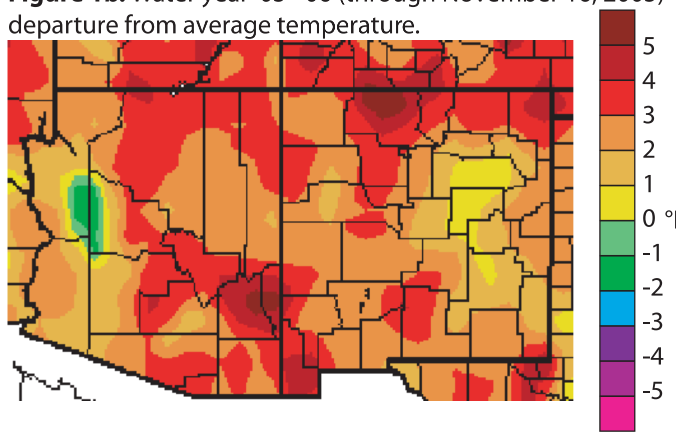


Figure 1c. Previous 30 days (October 18–November 16, 2005) departure from average temperature (interpolated).

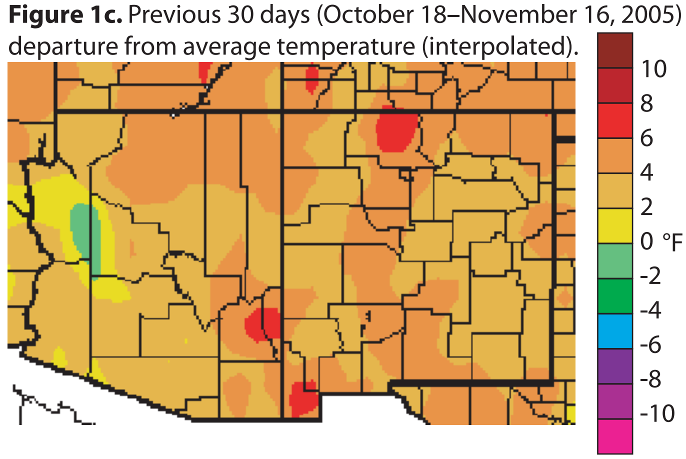
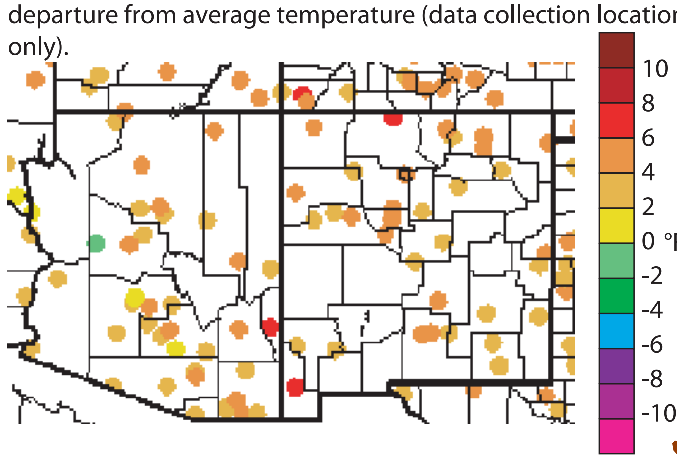


Figure 1d. Previous 30 days (October 18–November 16, 2005) departure from average temperature (data collection locations only).



Precipitation (through 11/16/05)

Source: High Plains Regional Climate Center

Water year precipitation has been below average for much of the Southwest, except for parts of southeastern New Mexico and far western Arizona, where precipitation has been above average (Figures 2a–b). Despite some scattered storm activity, much of southern and eastern Arizona, and northern and central New Mexico have received less than 50 percent of average precipitation. During the last 30 days, precipitation in all of New Mexico and eastern and southeastern Arizona has been considerably below average, with most of the region receiving only 25 percent or less of average precipitation, as shown in Figures 2c–d. Much of eastern New Mexico has received only 5 percent or less of average rainfall in the last month. In contrast, western Arizona has been wetter than average, where parts of Yuma, La Paz, and Mohave Counties experienced more than 200 percent of average precipitation.

The Tucson National Weather Service reports that rainfall of just under a third of an inch during October at the Tucson International Airport was about one quarter of average, and marks the 14th October in the last 15 years where below-average rainfall was recorded. The only occurrence of above-average October rainfall during that time was in 2000, when a record 4.98 inches were recorded.

Notes:

The water year begins on October 1 and ends on September 30 of the following year. As of October 1, 2005 we are in the 2006 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/products/current.html

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 '05–'06 through November 16, 2005 percent of average precipitation (interpolated).

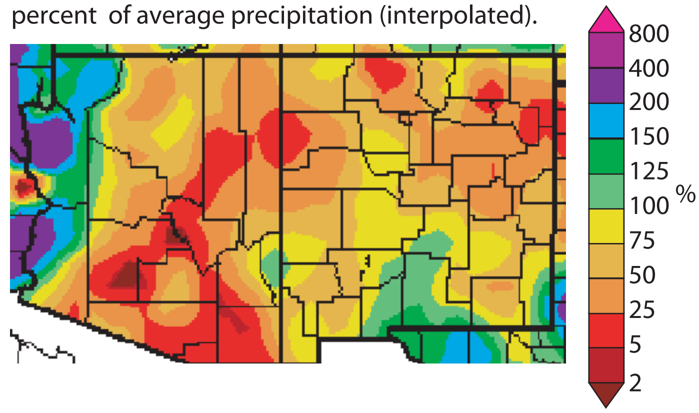


Figure 2b. Water year '05–'06 through November 16, 2005 percent of average precipitation (data collection locations only).

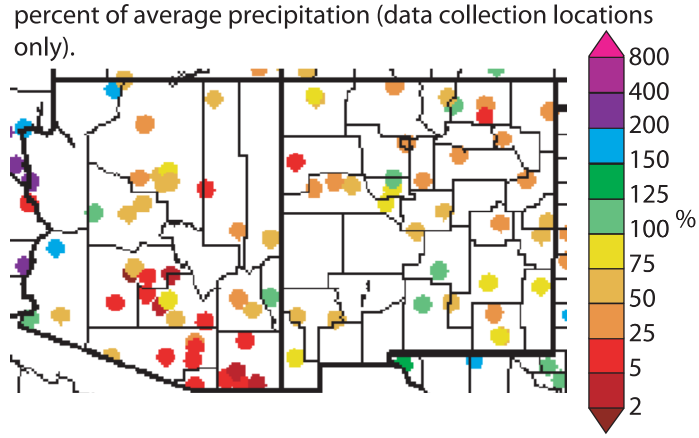


Figure 2c. Previous 30 days (October 18–November 16, 2005) percent of average precipitation (interpolated).

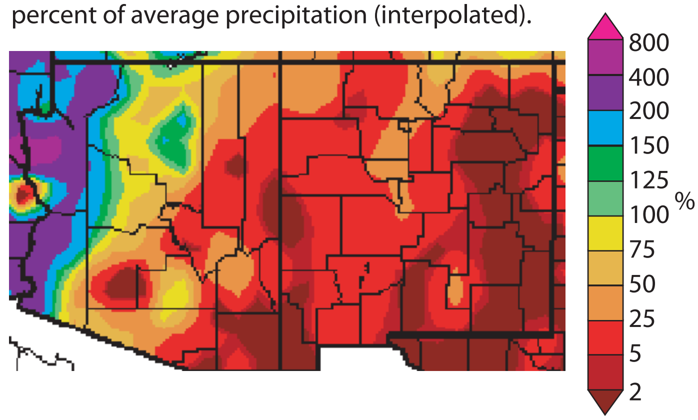
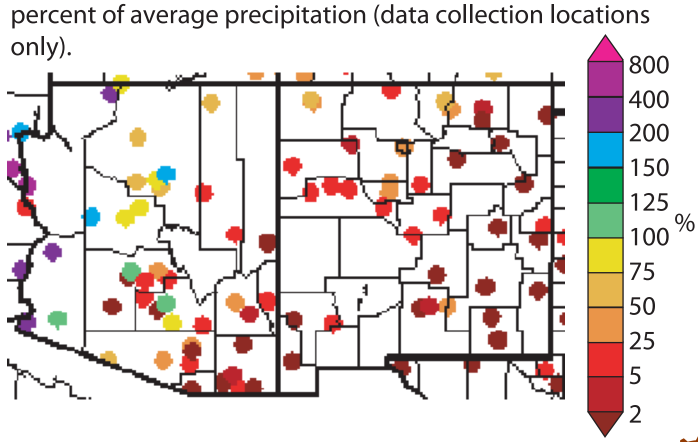


Figure 2d. Previous 30 days (October 18–November 16, 2005) percent of average precipitation (data collection locations only).



U.S. Drought Monitor

(released 11/17/05)

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

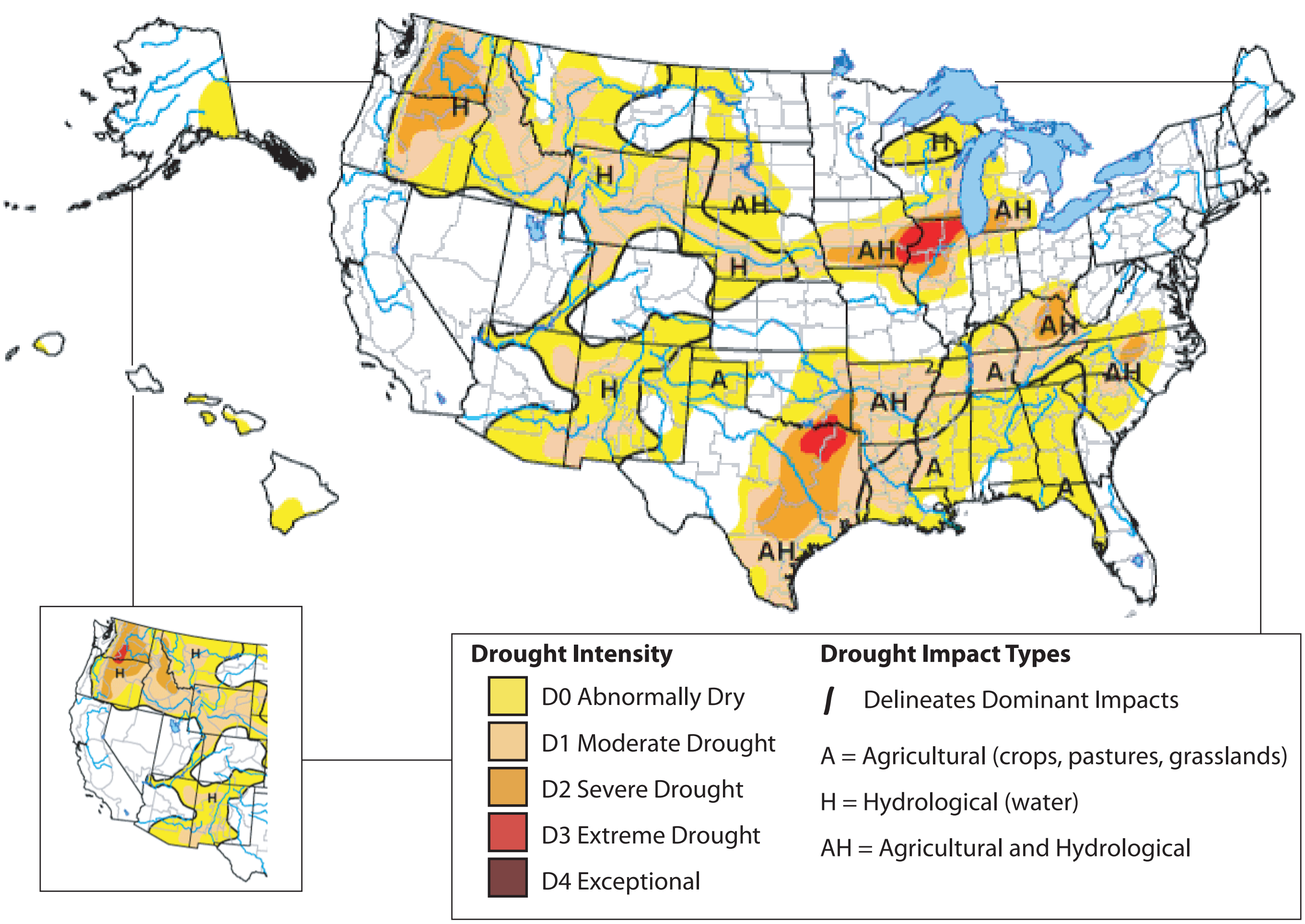
Drought conditions in Arizona have remained constant since mid-October, but in New Mexico abnormally dry conditions have extended eastward to include almost all of the state except parts of the upper Pecos River basin (Figure 3). Most of the region in drought or abnormally dry condition has received considerably below-average precipitation during the last six months, except for parts of the upper Pecos, which received up to 150 percent of normal rainfall over the last six months. Most of western and central Arizona is also now free of drought. Due to the abundant winter and spring precipitation, most of Arizona and New Mexico has shown marked improvement since this time last year, when much of the region was in severe to extreme drought. Officials rate 60 percent of the pasture and range land in Arizona as poor or very poor, 27 percent in New Mexico as poor to very poor. These numbers are 27 percent higher than average in Arizona and 12 percent lower than average in New Mexico. In the last four weeks, pasture and range lands in poor or very poor condition in Arizona has risen by 17 percent of average, and has fallen by one percent of average in New Mexico.

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 David Miskus, JAWF/CPC/NOAA.

Figure 3. Drought Monitor released November 17, 2005 (full size) and October 20, 2005 (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

New Mexico Drought Status
(through 11/17/05)

Source: New Mexico Natural Resources Conservation Service

Meteorological and hydrologic drought status in New Mexico is relatively unchanged since September. Despite some scattered storm activity during October, abnormally dry conditions extended eastward and now include most of the state except for parts of the upper Pecos River basin. According to the National Weather Service, temperatures across New Mexico during the month were generally close to or slightly below average. Precipitation was highly variable, with the southern half of the state and the northern mountains above average, while the remainder of New Mexico received below-average precipitation. Precipitation deficits over most of the state during the last six months have contributed to the persistence of drought in New Mexico. Many of the reservoirs on New Mexico rivers are well below average levels. Elephant Butte, the largest reservoir in the state, remains at 17 percent of capacity. Thanks to the abundant precipitation in the winter and spring, drought conditions in the state are considerably better than at this time last year, when much of the western and central portions of New Mexico were experiencing severe to extreme drought.

Figure 4a. Short-term drought map based on meteorological conditions as of September 16, 2005.

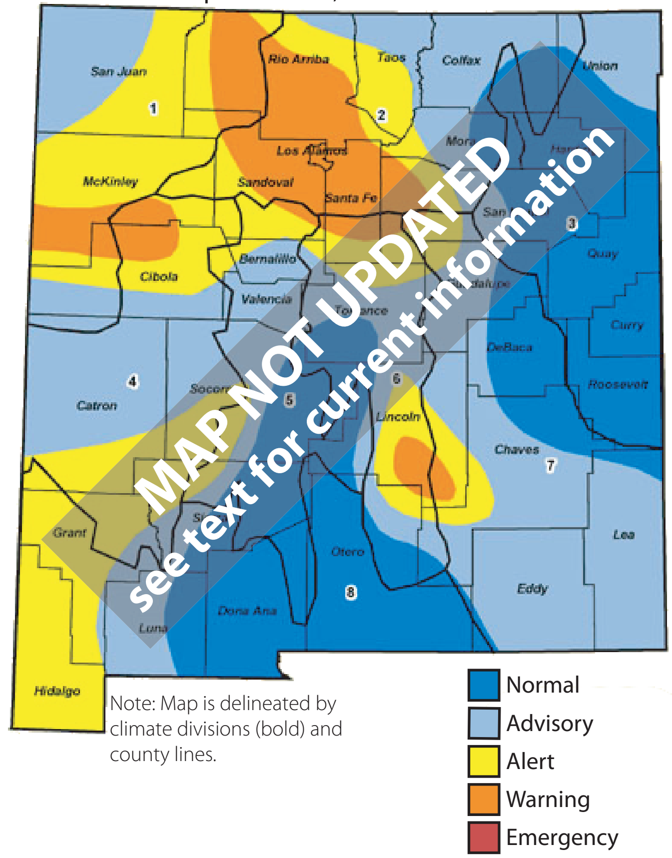
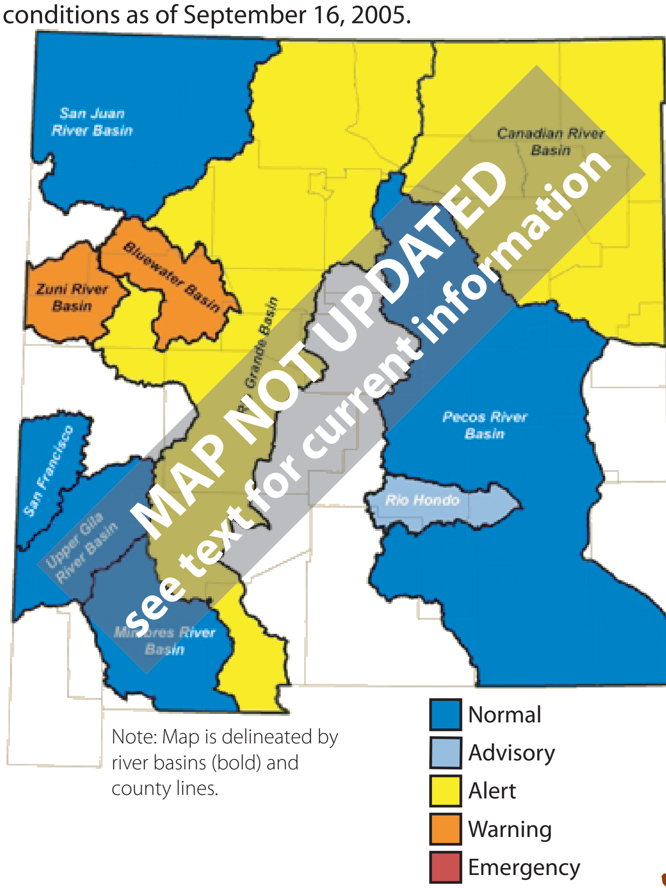


Figure 4b. Long-term drought map based on hydrological conditions as of September 16, 2005.



Notes:

The New Mexico drought status maps are produced monthly by the New Mexico Drought Monitoring Workgroup. When near-normal conditions exist, they are updated quarterly. 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 shortfalls (e.g., many months to years) on water supplies (i.e., streamflow, reservoir and lake levels, groundwater). This map is organized by river basins—the white regions are areas where no major river system is found.

On the Web:

For the most current New Mexico drought status map, visit:
http://www.nm.nrcs.usda.gov/snow/drought/drought.html

Information on Arizona drought can be found at:
http://www.azwater.gov/dwr/default.htm

Arizona Reservoir Levels

(through 10/31/05)

Source: National Water and Climate Center

Some reservoirs in Arizona declined slightly from September to October, while others increased in storage or held steady. Lake Powell and Lake Havasu on the Colorado River increased slightly, but most other reservoirs declined, except for Show Low Lake, which remains full, and Lyman reservoir, which held constant at 26 percent. Like last month, most reservoirs throughout the state remain well below capacity, except for the Salt River system (83 percent), Show Low Lake (100 percent), Lake Havasu (92 percent), and Lake Mohave (84 percent), as shown in Figure 5. Most reservoirs are near to well above last year's levels, due to the abundant winter and spring rains, except for Lake Havasu, which has declined slightly. The two largest reservoirs, Lake Mead and Lake Powell, remain above the storage recorded at the end of September a year ago, but they are both still well below their average storage levels. The reservoirs on both the Salt and Verde rivers are currently above their average levels, with the Salt River system at 154 percent of average, and the Verde River system at 110 percent of average.

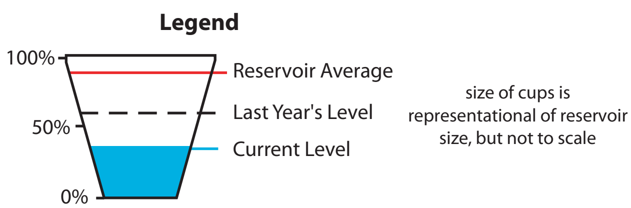
Notes:

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.

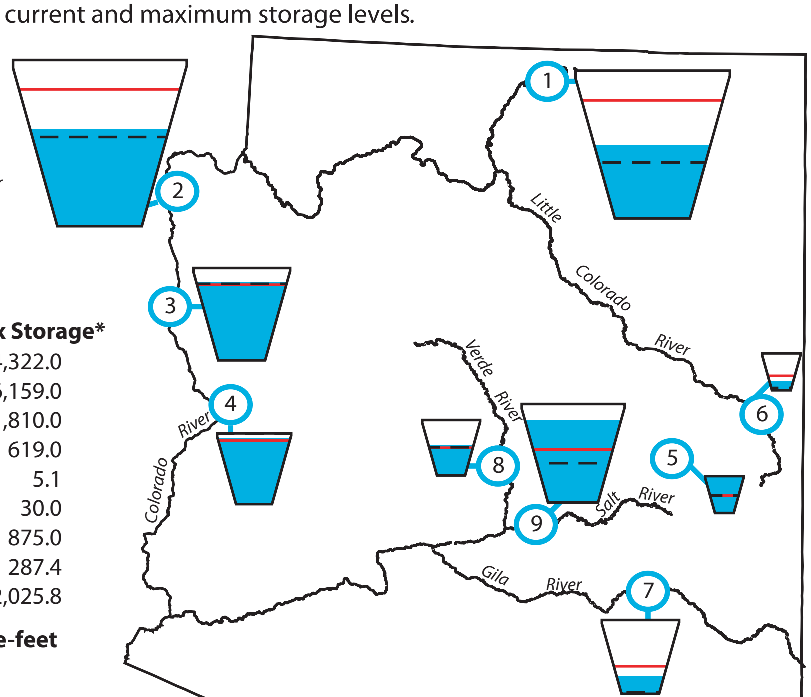
These data are based on reservoir reports updated monthly by the National Water and Climate Center of the U.S. Department of Agriculture's Natural Resource Conservation Service. For additional information, contact Tom Pagano at the National Water Climate Center (tpagano@wcc.nrcs.usda.gov; 503-414-3010) or Larry Martinez, Natural Resource Conservation Service, 3003 N. Central Ave, Suite 800, Phoenix, Arizona 85012-2945; 602-280-8841; Larry.Martinez@az.usda.gov).

Figure 5. Arizona reservoir levels for October 2005 as a percent of capacity. The map also depicts the average level and last year's storage for each reservoir, while the table also lists current and maximum storage levels.



Reservoir Name	Capacity Level	Current Storage*	Max Storage*
1. Lake Powell	49%	12,016.0	24,322.0
2. Lake Mead	58%	15,078.0	26,159.0
3. Lake Mohave	84%	1,527.2	1,810.0
4. Lake Havasu	92%	569.8	619.0
5. Show Low Lake	100%	5.1	5.1
6. Lyman Reservoir	26%	7.8	30.0
7. San Carlos	24%	213.5	875.0
8. Verde River System	55%	157.0	287.4
9. Salt River System	83%	1,676.0	2,025.8

*** 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 10/31/05)

Source: National Water and Climate Center

At the end of October most of the reservoirs across New Mexico remained well below capacity, except for Navajo Reservoir in the northwest, which ended the month at 89 percent of capacity, as shown in Figure 6. All of the reservoirs except Navajo, Heron, El Vado, and Costilla were below 50 percent capacity. As in Arizona, some reservoirs declined during the last month, some rose, and some remained steady. The largest change was at Sumner Reservoir on the Pecos River, which declined by 7 percent of capacity. About half of the reservoirs in the Rio Grande basin are below average levels, due to long-term precipitation deficits. Elephant Butte on the lower Rio Grande, the largest reservoir in the state, remained at only 17 percent of capacity. Caballo Reservoir, which had dropped to only 3 percent of capacity last month, gained slightly but was still at only 4 percent of capacity at the end of October. Abiquiu and Cochiti remained at 20 and 10 percent of capacity, respectively. As was the case in Arizona, the abundant precipitation in the winter and spring contributed to an increase in storage in most of the reservoirs compared to this time last year.

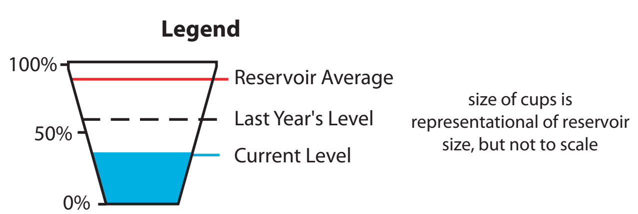
Notes:

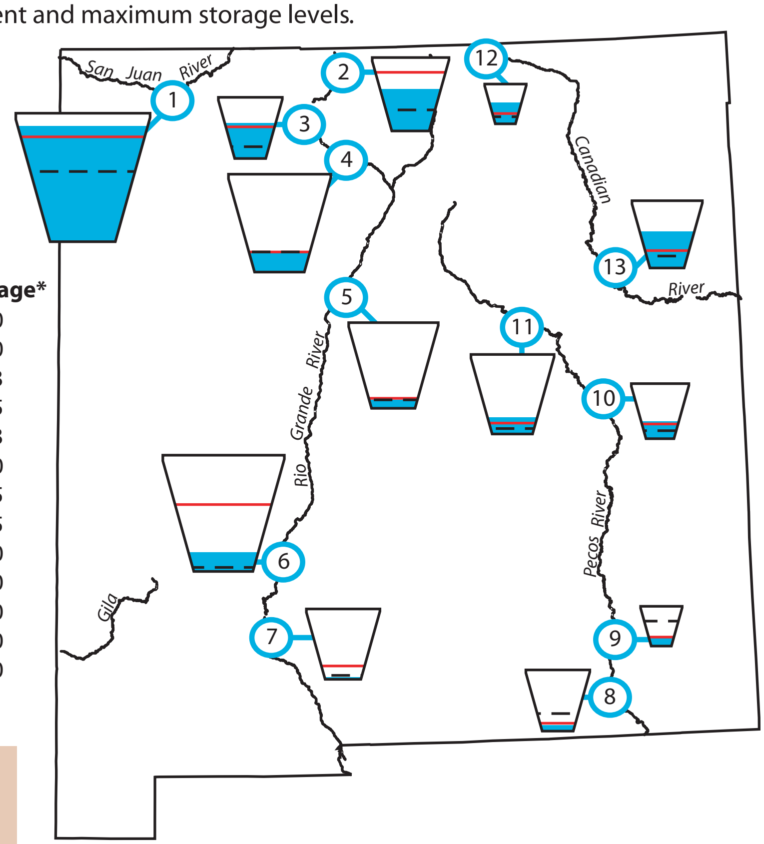
The map gives a representation of current storage levels for reservoirs in New Mexico. Reservoir locations are numbered within the blue circles on the map, corresponding to the reservoirs listed in the table. The cup next to each reservoir shows the current storage level (blue fill) as a percent of total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

The table details more exactly the current capacity level (listed as a percent of maximum storage). Current and maximum storage levels are given in thousands of acre-feet for each reservoir.

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. For additional information, contact Tom Pagano at the National Water Climate Center (tpagano@wcc.nrcs.usda.gov; 503-414-3010) or Dan Murray, NRCS, USDA, 6200 Jefferson NE, Albuquerque, NM 87109; 505-761-4436; Dan.Murray@nm.usda.gov).

Figure 6. New Mexico reservoir levels for October 2005 as a percent of capacity. The map also depicts the average level and last year's storage for each reservoir, while the table also lists current and maximum storage levels.





Reservoir Name	Capacity Level	Current Storage*	Max Storage*
1. Navajo	89%	1,516.4	1,696.0
2. Heron	58%	230.4	400.0
3. El Vado	58%	108.6	186.3
4. Abiquiu	20%	111.5	554.5
5. Cochiti	10%	48.5	502.3
6. Elephant Butte	17%	349.2	2,065.0
7. Caballo	4%	12.5	331.5
8. Brantley	10%	15.0	147.5
9. Lake Avalon	25%	1.5	6.0
10. Sumner	32%	32.5	102.0
11. Santa Rosa	21%	94.3	447.0
12. Costilla	54%	8.7	16.0
13. Conchas	40%	100.9	254.0

*** thousands of acre-feet**

On the Web:

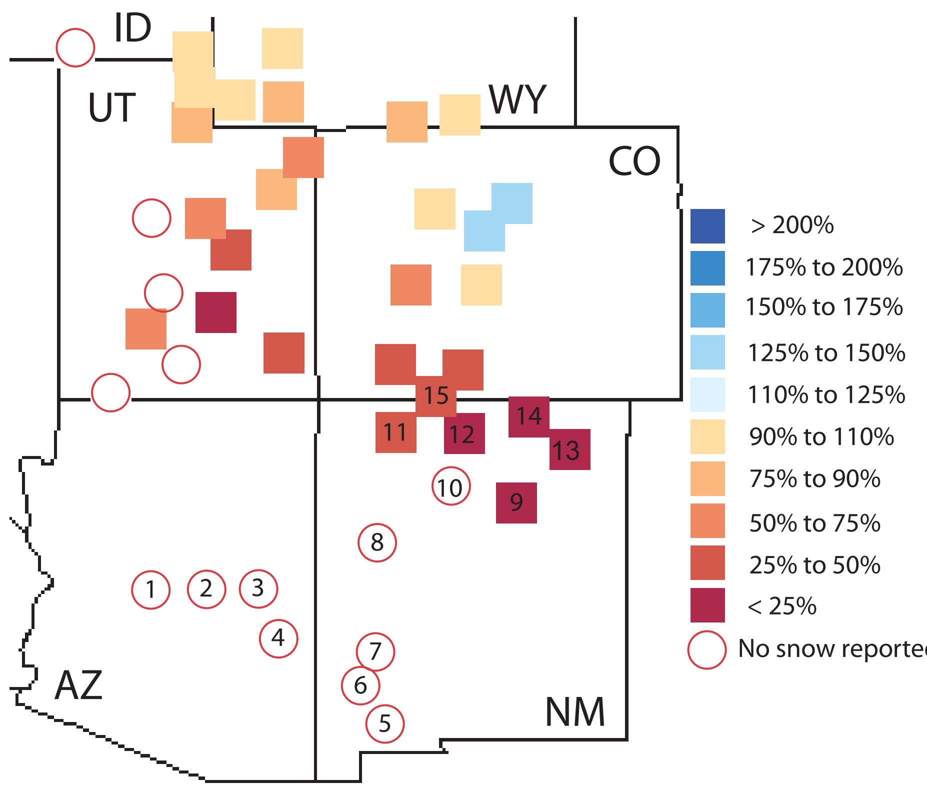
Portions of the information provided in this figure can be accessed at the NRCS website: http://www.wcc.nrcs.usda.gov/wsf/reservoir/resv_rpt.html

Southwest Snowpack
(updated 11/17/05)

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

Snowpack telemetry (SNOTEL) sites in northern New Mexico have recorded below-average basin snow water content as of November 17 (Figure 7). Pecos River, Rio Chama River Basin, Cimarron River Basin, and Sangre de Cristo Mountain Range basins all recorded less than 25 percent of average while the San Miguel, Dolores, Animas, and San Juan River basins and the San Juan River Headwaters recorded 25–50 percent of average. As of November 17, other sites in Arizona and New Mexico had not yet reported snow. In Flagstaff, the median date for the first snowfall is November 6. At Bright Angel Ranger Station in Grand Canyon National Park, first snowfall has most often been October 28, according to the National Climatic Data Center (NCDC). In Albuquerque, the median first date for snowfall is November 14 (NCDC). Above-average temperatures and below-average precipitation in October (see Figures 1–2) have contributed to below-average basin snow water content in the Southwest.

Figure 7. Average snow water content (SWC) in percent of average for available monitoring sites as of November 17, 2005.



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

On the Web:
For color maps of SNOTEL basin snow water content, visit: http://www.wrcc.dri.edu/snotelanom/basinswe.html

For a numeric version of the map, visit: http://www.wrcc.dri.edu/snotelanom/basinswen.html

For a list of river basin snow water content and precipitation, visit: http://www.wrcc.dri.edu/snotelanom/snotelbasin

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 7 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.

Temperature Outlook

(December 2005–May 2006)

Source: NOAA Climate Prediction Center (CPC)

NOAA-CPC forecasts call for increased chances of warmer-than-average temperatures for the Southwest through May 2006 (Figure 8a–d). The December–February forecast indicates greater chances of above-average temperatures for much of the West and Midwest (Figure 8a). In the Southwest, areas with highest probabilities (more than 50 percent) are centered over Arizona and New Mexico and include west Texas and parts of southern Nevada, Utah, and Colorado. As the forecasts progress to February–April, chances for above-average temperature increase to more than 60 percent in northwestern Arizona (Figure 8c). In terms of snowfall, warmer winter temperatures in the Southwest could affect the winter snowpack, the ski industry, and spring runoff important for reservoirs.

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 8a. Long-lead national temperature forecast for December 2005–February 2006.

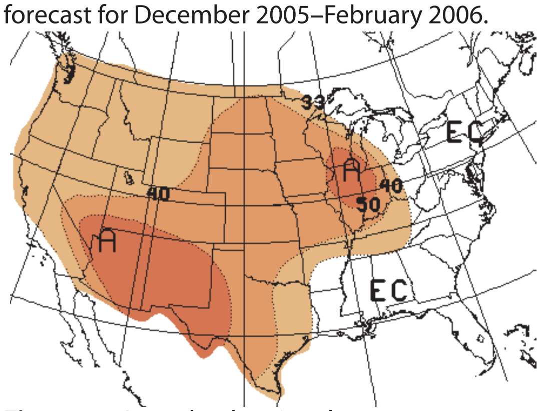


Figure 8b. Long-lead national temperature forecast for January–March 2006.

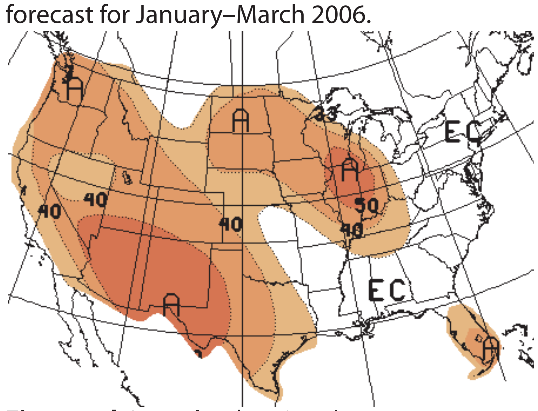


Figure 8c. Long-lead national temperature forecast for February–April 2006.

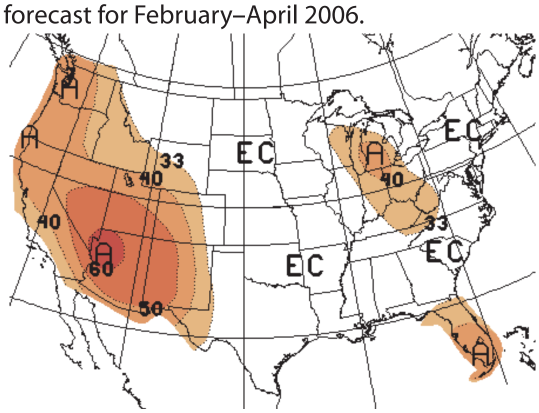
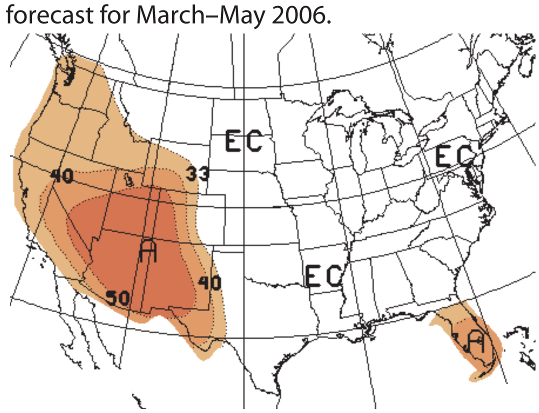
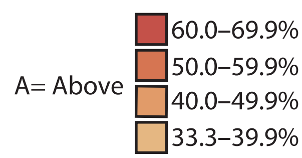


Figure 8d. Long-lead national temperature forecast for March–May 2006.





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
(December 2005–May 2006)
Source: NOAA Climate Prediction Center (CPC)

Forecasters from NOAA-CPC have reserved judgment on precipitation for most of the country, including the Southwest, through May 2006 (Figure 9a–d). Florida and parts of southeastern Alabama, Georgia, and South Carolina are projected to have increased chances for drier conditions through the winter (Figure 9a–b). The International Research Institute for Climate and Society (IRI) forecasts (not shown) agree with NOAA-CPC forecasts. Generally, precipitation forecasts are more difficult to make during neutral El Niño Southern Oscillation (ENSO) conditions (see Figures 11a–b).

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 9a. Long-lead national precipitation forecast for December 2005–February 2006.

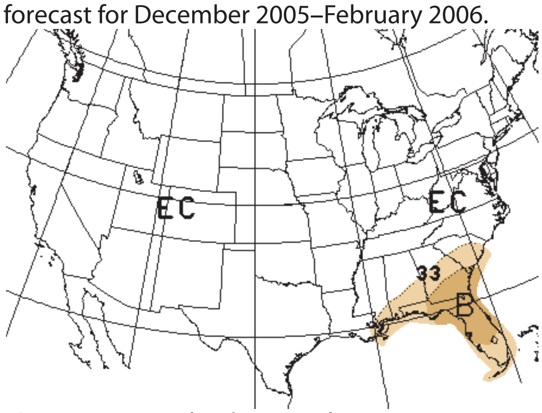


Figure 9b. Long-lead national precipitation forecast for January–March 2006.

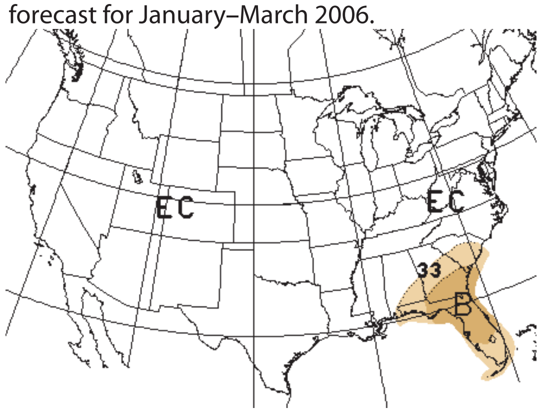


Figure 9c. Long-lead national precipitation forecast for February–April 2006.

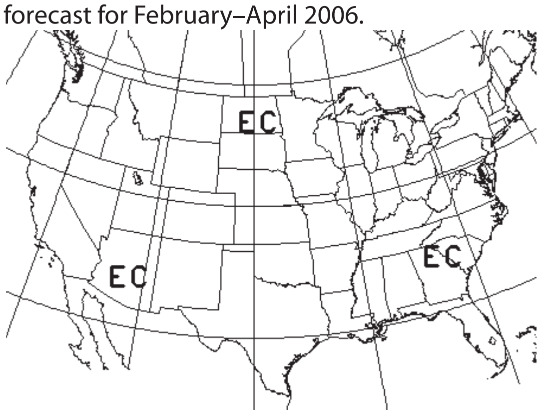
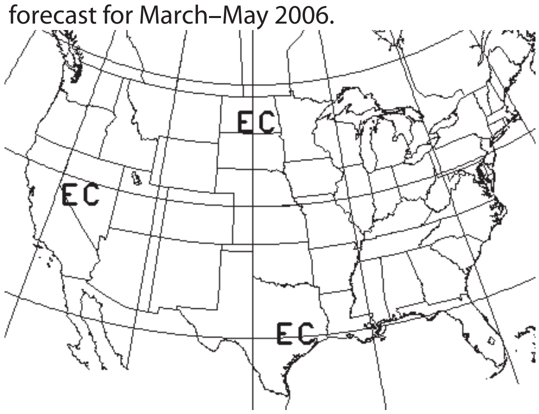


Figure 9d. Long-lead national precipitation forecast for March–May 2006.



B= Below 33.3–39.9% 40.0–49.9%

EC= Equal chances. No forecasted anomalies.

On the Web:
For more information on CPC forecasts, visit:
http://www.cpc.ncep.noaa.gov/products/predictions/multi_season/13_seasonal_outlooks/color/churchill.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 February 2006)

Source: NOAA Climate Prediction Center (CPC)

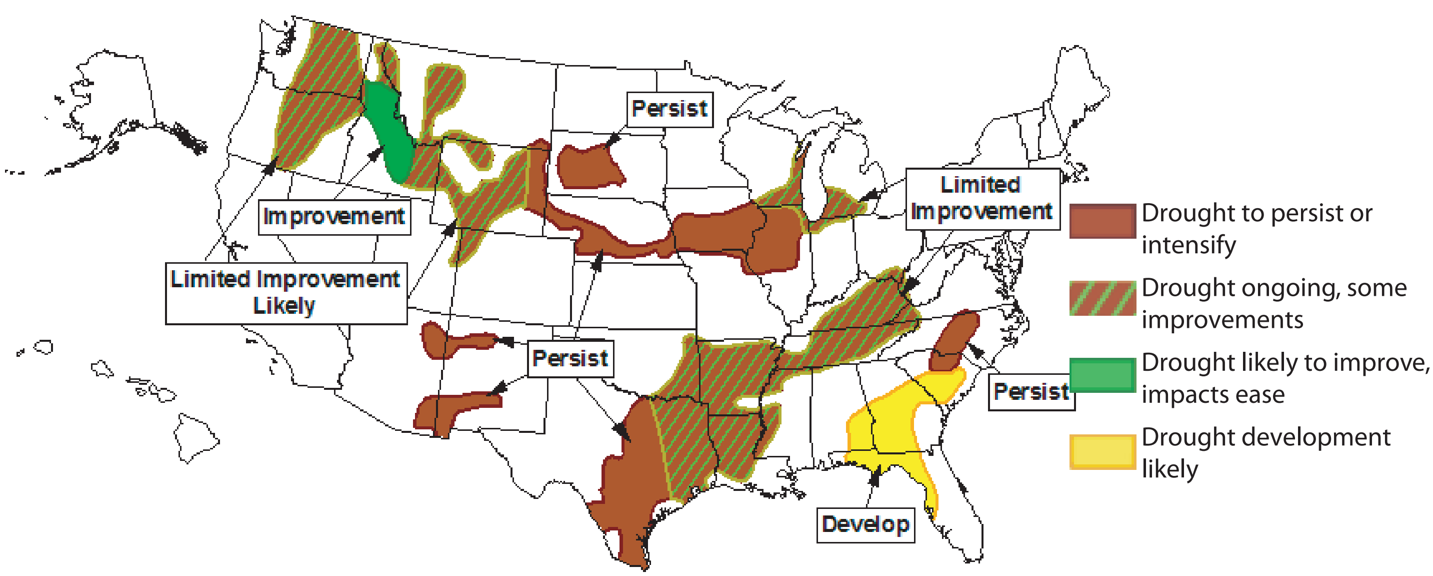
The seasonal drought outlook from the NOAA-CPC calls for drought to persist along parts of the Arizona and New Mexico border (Figure 10). Despite some rain in October, those areas are not expected to receive enough precipitation to improve their current drought status, in part because of long-term precipitation deficits over the last 48–72 months. The recent dryness (since May) in New Mexico has contributed to the moisture deficits in the western part of the state. Continued above-average temperatures also have led to the persistence of drought in the Southwest. Because ENSO-neutral conditions are likely to continue into 2006, confidence in seasonal forecasting is not especially high right now. However, some models suggest that the coming winter is likely to be either average or drier than average. In addition, the CPC outlook calls for above-average temperatures throughout the region, making drought improvement unlikely.

New research documenting the die-off of millions of pinyon pines throughout the Southwest has revealed the underlying cause of death to be the high heat that accompanied the recent drought. The research team was led by David D. Breshears, a professor of natural resources in the University of Arizona's School of Natural Resources and a member of the Institute for the Study of Planet Earth. Not as many trees died during a previous multi-year drought in the 1950s, but temperatures were not as high as in the current drought.

The extremely high temperatures of the current drought put the trees under so much water stress that they became susceptible to attacks by bark beetles, and were finished off by the insects. It will take decades for the slow-growing pinyon pines to repopulate the woodlands if wet weather returns. But if the drought persists, species from drier ecosystems will likely replace the pinyons. The lack of pinyon nuts will have negative impacts on wildlife and on people who harvest the nuts.

Notes:
The delineated areas in the Seasonal Drought Outlook (Figure 10) are defined subjectively and are based on expert assessment of numerous indicators, including outputs of short- and long-term forecasting models.

Figure 10. Seasonal drought outlook through February 2006 (release date November 17, 2005).



On the Web:
For more information, visit:
http://www.drought.noaa.gov/

El Niño Status and Forecast

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

Sea-surface temperatures remain near average across the equatorial Pacific, and El Niño Southern Oscillation (ENSO) conditions remain neutral. Southern Oscillation Index (SOI) values (an indication of atmospheric-Pacific Ocean interaction) have increased during the past few months, though values are still within ENSO-neutral ranges (Figure 12a). There is a 100 percent likelihood of maintaining neutral ENSO conditions through the end of 2005, according to IRI probabilistic forecasts (Figure 12b). IRI also predicts that the chances of La Niña conditions developing before the end of 2005 are approximately 1 percent. By late spring 2006, chances for El Niño become greater than the average historical probability of 25 percent. Historically, El Niño conditions have been associated with above-average rainfall in the Southwest, while neutral conditions have little effect on precipitation.

Figure 11a. The standardized values of the Southern Oscillation Index from January 1980–October 2005. 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).

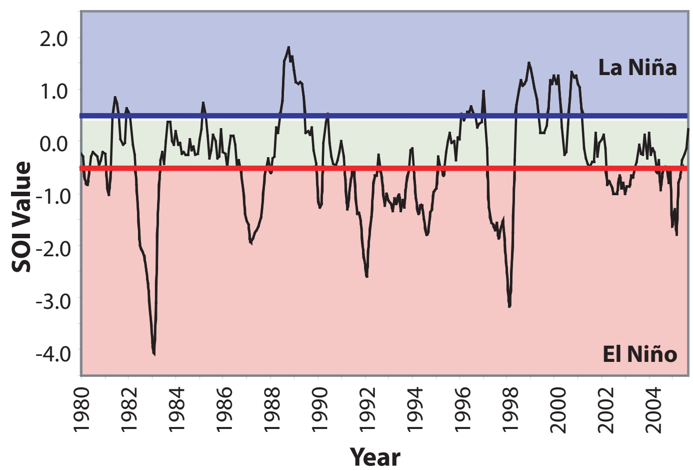
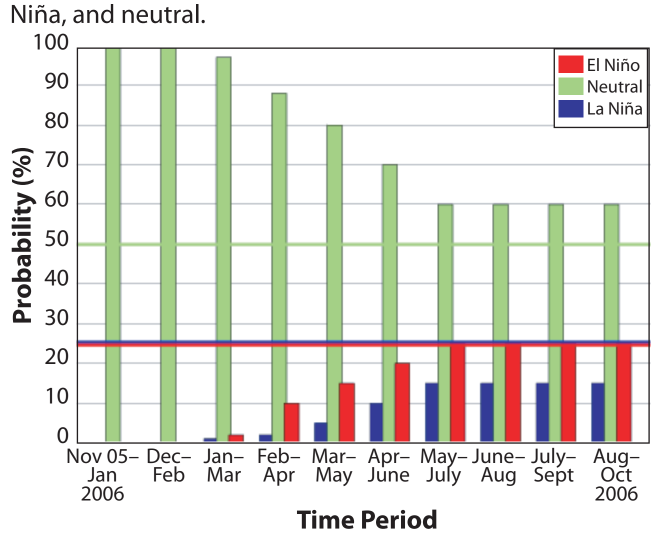


Figure 11 b. IRI probabilistic ENSO forecast for El Niño 3.4 monitoring region (released November 17, 2005). Colored lines represent average historical probability of El Niño, La Niña, and neutral.



Notes:

Figure 11a shows the standardized three month running average values of the Southern Oscillation Index (SOI) from January 1980 through October 2005. 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 11b shows the International Research Institute for Climate Prediction (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/

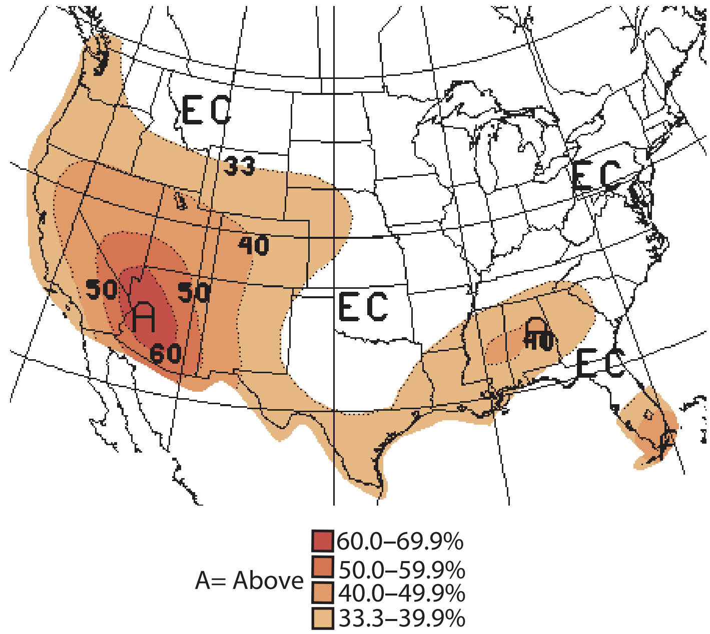
Temperature Verification

(August–October 2005)

Source: NOAA Climate Prediction Center (CPC)

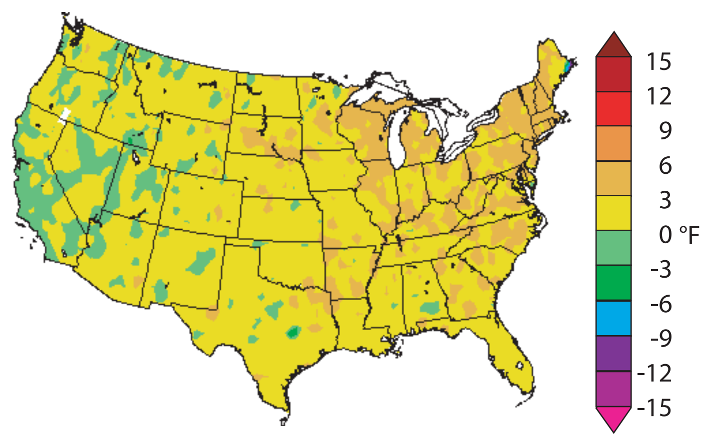
The long-range forecast for August–October 2005 from the NOAA-CPC predicted increased chances of above-average temperatures throughout most of the Southwest, much of the southern and central plains and into the Pacific Northwest, and in much of the Southeast (Figure 12a). The area of highest probability was in the Southwest, centered in western Arizona, extending into New Mexico, Colorado, Utah, Nevada, and California. No probabilities for cooler-than-average temperatures were forecast. Observed temperatures across most of the nation ranged from 0–3 degrees Fahrenheit (F) above average, with extensive areas of 3–6 degrees F above average throughout most of the Northeast and much of the eastern half of the country (Figure 12b). The western third of the country had broad areas of 0–3 degrees F below-average temperatures, particularly in California, Nevada, and western Arizona. Generally the forecast performed well in predicting above-average temperatures in the South and most of the Southwest.

Figure 12a. Long-lead U.S. temperature forecast for August–October 2005 (issued July 2005).



EC= Equal chances. No forecasted anomalies.

Figure 12b. Average temperature departure (in degrees F) for August–October 2005.



Notes:

Figure 12a shows the NOAA Climate Prediction Center (CPC) temperature outlook for the months August–October 2005. This forecast was made in July 2005.

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 12b shows the observed departure of temperature (degrees F) from the average for the August–October 2005 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.

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
(August–October 2005)
Source: NOAA Climate Prediction Center (CPC)

The long-range outlook from the NOAA-CPC for August–October 2005 predicted increased chances of below-average precipitation throughout much of the Southwest, including most of California, and southeastern Oregon and southern Idaho, with the highest probability centered over a small area in northern Nevada (Figure 13a). Above-average precipitation was predicted for parts of the Southeast near the eastern seaboard. Precipitation was generally below average in agreement with the forecast in Arizona and western New Mexico, and in northern California and Nevada, southern Idaho and the Pacific Northwest (Figure 13b). The forecast did well in predicting the overall drier-than-average conditions in the Southwest and far West, but failed to predict the much wetter-than-average band of precipitation extending from southern California and western Arizona through southern Nevada and Utah into Colorado. The model performed less well in the Southeast, where above-average precipitation was predicted. Most of the region experienced below-average precipitation except for a narrow strip along the Atlantic coastline.

Figure 13a. Long-lead U.S. precipitation forecast for August–October 2005 (issued July 2005).

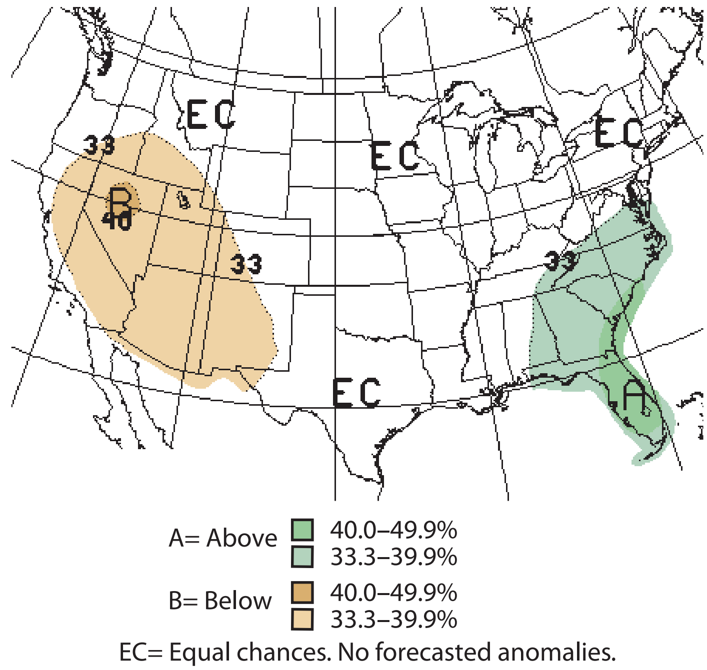
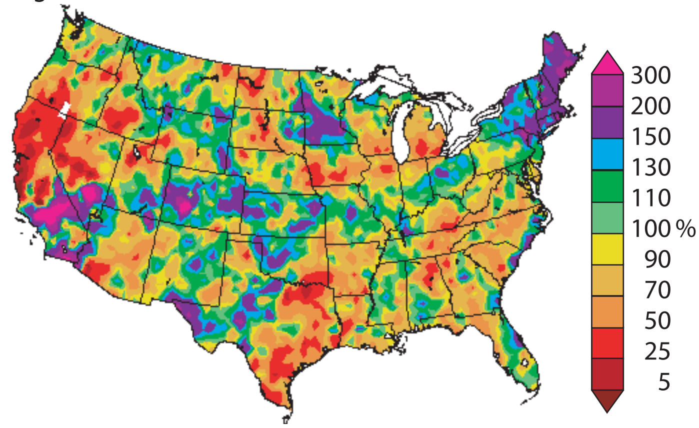


Figure 13b. Percent of average precipitation observed from August–October 2005.



Notes:

Figure 13a shows the NOAA Climate Prediction Center (CPC) precipitation outlook for the months August–October 2005. This forecast was made in July 2005.

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 13b shows the observed percent of average precipitation for August–October 2005. 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