Issued: February 22, 2005

CLIMAS
Southwest Climate Outlook

February Climate Summary

Hydrological Drought – Hydrological drought has eased in much of the Southwest.

- Portions of Arizona and New Mexico have been removed from drought status.
- Many reservoirs have held steady or increased due to recent precipitation.

Precipitation – Above-average precipitation fell across Arizona and New Mexico over the past 30 days. Snowpack is also above average in many regional river basins.

Temperature – Temperatures have been above average over the past 30 days and throughout the current water year.

Climate Forecasts – Long-lead forecasts indicate increased chances of warmer-than-average conditions in Arizona and New Mexico through August. Increased chances of above-average precipitation are predicted through May.

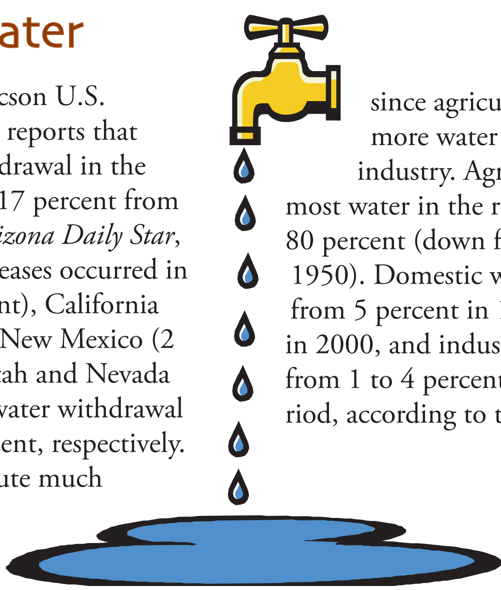
El Niño – A weak El Niño continues in the tropical Pacific Ocean. Forecasts call for a greater likelihood of neutral conditions from mid-summer to early 2006.

The Bottom Line – Drought conditions are expected to improve in the coming months, although large reservoir levels will remain low.

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

Groundwater

A study by the Tucson U.S. Geological Survey reports that groundwater withdrawal in the Southwest fell by 17 percent from 1975 to 2000 (*Arizona Daily Star*, January 27). Decreases occurred in Arizona (28 percent), California (23 percent), and New Mexico (2 percent), while Utah and Nevada increased groundwater withdrawal by 30 and 13 percent, respectively. Researchers attribute much of the decrease to fewer farms, since agriculture tends to use more water than households and industry. Agriculture still used the most water in the region in 2000, about 80 percent (down from 94 percent in 1950). Domestic water use increased from 5 percent in 1950 to 16 percent in 2000, and industrial use increased from 1 to 4 percent over the same period, according to the study.



In this issue:

The Southwest Climate Outlook is jointly published each month by the Climate Assessment for the Southwest project and the University of Arizona Cooperative Extension.

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Is global warming creeping into Southwest forests?

Evidence building that warming is already affecting the region

BY MELANIE LENART

How do we recognize global warming when we come face to face with it? And if we see it—perhaps in the form of millions of acres of beetle-ravaged forests, or when half the remaining red squirrel habitat goes up in flames—how do we convey that message to the public?

These questions peppered the talks at a Sedona workshop in mid-February that drew forest managers and scientists together for an exchange of views on climate variability and change. The workshop was sponsored by the University of Arizona Cooperative Extension Service, and organizers also included the UA's Climate Assessment for the Southwest and Northern Arizona University.

Climate change, a.k.a. global warming, may be stoking the flames of southwestern wildfires, and promoting "woody encroachment" of grasslands, issues that concern land managers.

Has the warming already started?
Mean annual temperature in the Southwest could rise by as much as a toasty 10 to 14 degrees Fahrenheit or more by the end of the century, pointed out Jonathan Overpeck, director of the UA's Institute for the Study of Planet Earth, citing results of a January 27 *Nature* article.

The Intergovernmental Panel on Climate Change (IPCC) has long predicted global warming would result from the input of greenhouse gases from cars and electrical production. A growing body of evidence suggests the warming already kicked in during the previous century, especially the last quarter (Figure 1).

Mean annual temperature climbed by about one degree Fahrenheit per decade in Arizona between 1970 and 2004, according to an online analysis at the National Climate Data Center website. So a warming of 10 degrees by the end of this century would be merely following the existing trend since 1970. In New Mexico, the ascent was less steep, at about 0.6 degrees per decade for the same time frame. Both rates are higher than the 0.5 degrees per decade for the United States overall for that time period.

In past reports, the IPCC predicted the warming would be greater during cool seasons. In both Arizona and New Mexico, the warming since 1970 is greatest in spring. This mirrors the national trend toward an earlier spring, which in effect means a shorter winter.

The IPCC also predicted that the poles would warm more rapidly than the planet as a whole. In fact, the warming around the North Pole is happening even faster than scientists expected, and many consider the melting ice a harbinger of things to come.

"The signal-to-noise problem that might exist in other parts of the world doesn't exist there," Overpeck told the roughly 100 workshop participants. He recalled a recent trip to the Arctic where he was awakened in his tent by the sounds of running water and chirping birds during the normally frozen spring. Sea ice has thinned by a quarter to half its original depth depending on location since submarines began measurements in the 1950s, he noted.

Such compelling evidence for global warming helped convince most of the world to support the Kyoto treaty, which went into effect last week with the support of 141 nations. The United States and Australia are the only industrialized countries that have not signed on to the pact to help slow the rate of global warming by reducing emissions of greenhouse gases like carbon dioxide.

It's somewhat more difficult to separate a long-term climate warming "signal" from the garden variety ups and downs ("noise") of natural climate variability in the mountainous western United States than in the Arctic. Temperatures drop at an average rate of about 3 degrees Fahrenheit for every 1,000-foot increase in altitude, making it more challenging to calculate averages. Too, the Southwest's semi-arid nature makes it a land of extremes, in rainfall as well as temperature.

Impacts of higher temperatures
Even so, the warming trend of recent decades appears to have spurred insect outbreaks in high-elevation southwestern forests, reported Thomas Swetnam, director of the UA Laboratory of Tree-Ring Research.

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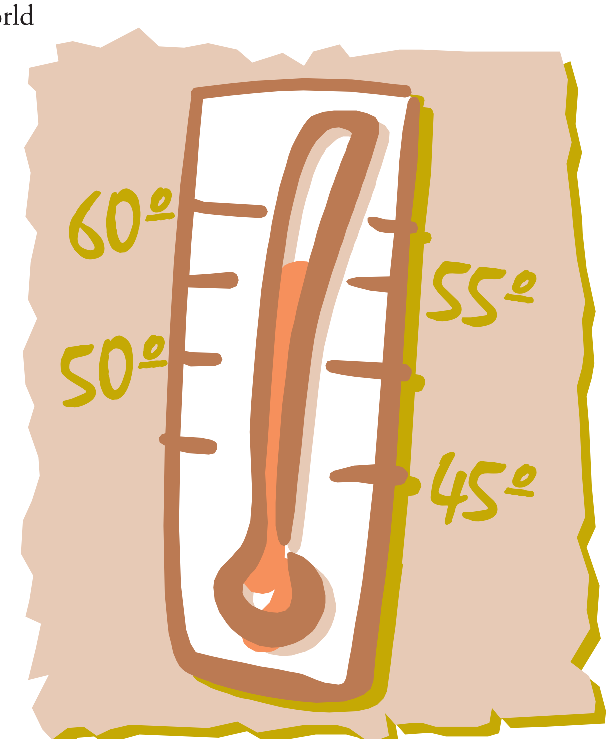


Warming, continued

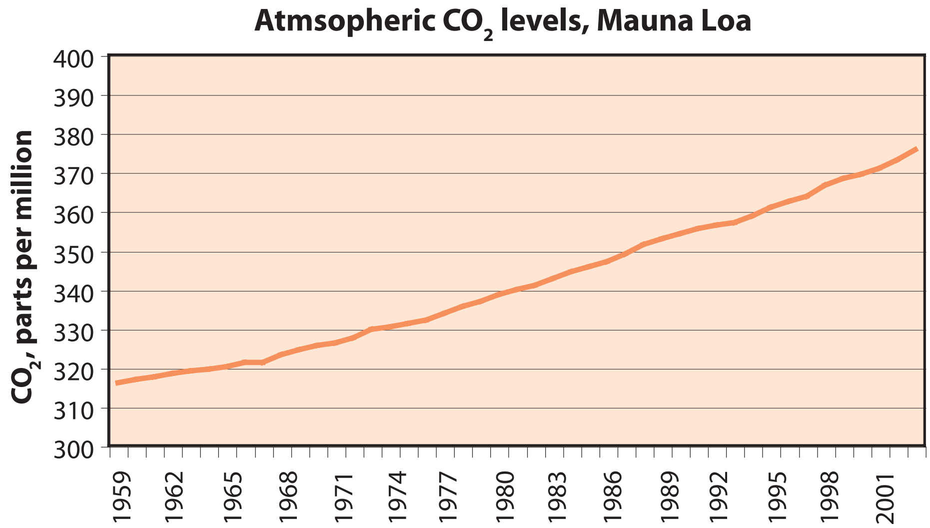
The variety of insects feasting on the spruce-fir forests atop Arizona's Mount Graham near Tucson included exotic maritime species that hadn't been seen in this region before, he noted. The dead trees then contributed volatile pitch and fuel to a fire last summer that burned to varying degrees about half of the spruce-fir forests there—the world's only habitat for the endangered Mount Graham red squirrel.

"The combined warmth and drought may be the real kicker here," Swetnam told the group. After also discussing recent increases in the scale of southwestern wildfires, he said, "Maybe we're at that point where we can say climate change is affecting the Southwest."

Unfortunately, high-elevation forests rarely host weather stations. One that does—the McNary station at 7,340 feet in elevation—shows a decrease since 1940 in the number of days without significant frost events, based on an analysis by U.S. Forest Service researcher Ann Lynch (Figure 2). Lynch, Swetnam and others consider these higher temperatures related to the severity of insect invasions of recent years.

Bark beetles damaged roughly four times as many acres of Arizona forests during peak outbreak years of the current drought compared to the 1950s drought. Airplane assessments tallied 1.9 million acres damaged in 2003, compared to 490,000 acres in 1957, according to data collected by U.S. Forest Service entomologist Roberta Fitzgibbons. (Another 860,000 acres were damaged in New Mexico in 2003.) The good news is the attacks on Arizona forests appear to have waned, she indicated, with a drop to 135,000 acres damaged statewide in 2004.

Meanwhile, about 18 million acres of Canadian forests were being ravaged, Swetnam noted. In addition, Canadian researchers have linked regional temperature increases to acres-burned in recent wildfires, he said, citing research reported in the September 2004 issue of *Geophysical Research Letters.*



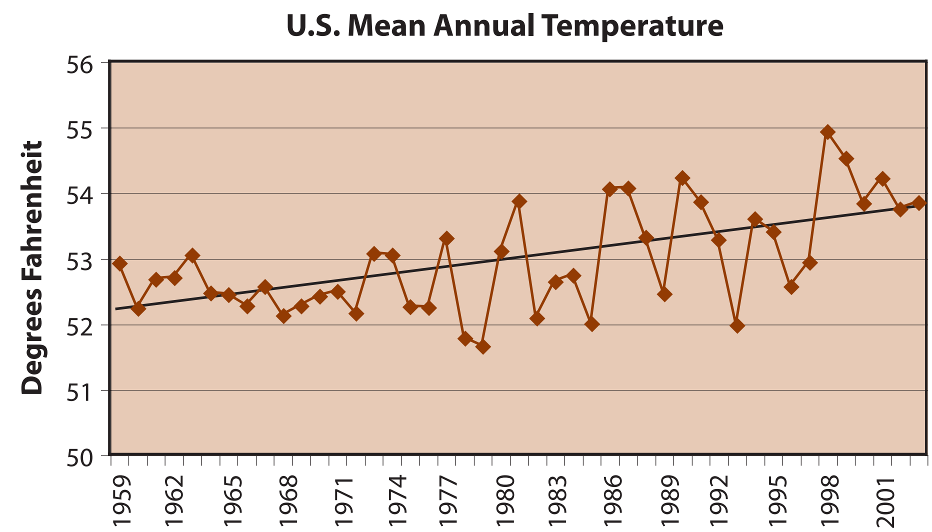


Figure 1. Carbon dioxide levels (top figure) as measured on the Hawaiian island of Mauna Loa depict the ongoing rise of this greenhouse gas in the atmosphere. C.D. Keeling and his colleagues began collecting these measurements in 1958. Data for average annual temperature in the United States are also plotted for this same time period (bottom figure), with means estimated by the National Climatic Data Center based on available weather stations. As predicted, rising carbon dioxide rates are associated with rising temperatures, although other factors also are involved in the annual ups and downs. Source for carbon dioxide measurements: Keeling and Whorf data sets available at http://cdiac.esd.ornl.gov/ftp/trends/co2/maunaloa.co2. Source for U.S. temperature data set: http://www.ncdc.noaa.gov/oa/climate/research/cag3/cag3.html.

Western U.S. wildfires have also been on the rise as temperature climbs, although other factors come into play. For instance, the suppression of surface fires in Ponderosa pine forests promoted proliferation of seedlings and saplings, as did the harvesting of large trees. A wet period centered on the 1980s encouraged seedling and tree growth beyond what drought can support. On top of this, the carbon dioxide that enhances the Earth's natural greenhouse effect also serves as a fertilizer for trees and other plants.

As a result, many interior southwestern forests contain roughly twice the amount of biomass—i.e., the com-

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Warming, continued

bined dry weight of the living and dead vegetation—than would be expected given a natural fire regime, explained Ron Neilson, a U.S. Forest Service researcher based in Oregon who heads the Mapped Atmosphere-Plant-Soil System (MAPSS) project. Models he constructed with his colleagues suggest that only about one-eighth of the U.S. acreage that would naturally burn each year does so. Fire suppression thus encourages an unnatural build-up of biomass.

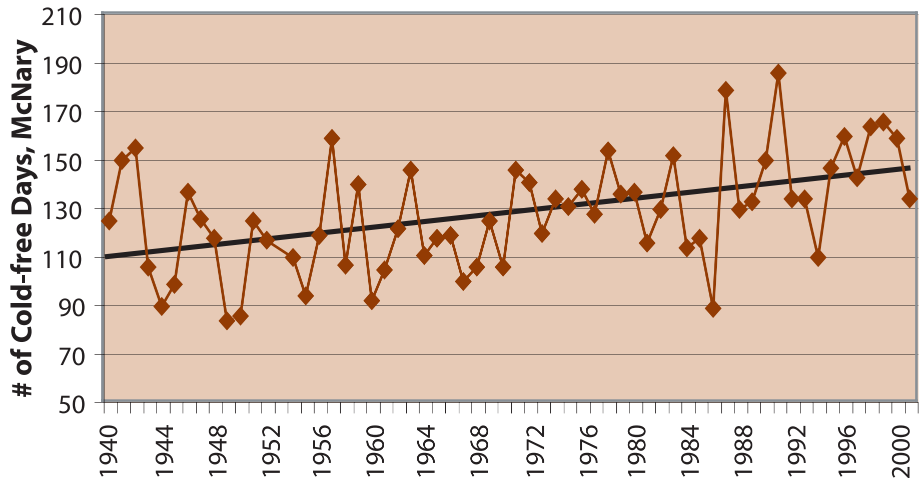

Figure 2. The length of time between frost events lasting more than a few hours in McNary, Arizona, has grown on average by roughly half a day each year, based on an analysis of daily temperatures by researcher Ann Lynch. This analysis excluded "isolated frost days," i.e., those with 10 frost-free days on either side. Source: Ann M. Lynch, research entomologist with the U.S. Department of Agriculture Forest Service Rocky Mountain Research Station in Flagstaff.

Managing dense forests

This "woodification" of forests, as some speakers called it, fuels the large-scale wildfires that have plagued the Southwest during dry years. For instance, the 2000 Cerro Grande fire around Los Alamos was the largest wildfire in New Mexico's history with about 47,000 acres burned. Two years later, the 2002 Rodeo-Chediski fire in northern Arizona's White Mountains burned about 460,000 acres, making it an order of magnitude larger than any other fire in Arizona's documented history.

Some forest managers, such as those in Arizona's White Mountains, are responding to the risk by thinning some of the smaller trees in the forests near residential communities.

"Going out there and thinning the wood is a good idea, but you're bucking the tide," Neilson told the group.

In addition to being a huge undertaking, thinning treatments are an expensive task. Few sawmills remain in the Southwest, except on tribal lands. This poses a dilemma for national and state forest managers trying to clear the smaller trees that increase fire risk yet yield little to no profit to loggers after transportation costs. As a result, the standard thinning rate for small-tree thinning treatments is $400 to $1,000 an acre.

Prescribed burning is also used by some forest managers, particularly on tribal lands, such as northern Arizona's Apache reservations, and in New Mexico's Gila National Forest. Although this technique can be more efficient than thinning when it works, air-quality restrictions and the high fuel build-ups can make this approach challenging to adopt and safely carry out in overgrown forests. The Cerro Grande fire started from a prescribed burn, for instance.

In addition to struggling to reduce fire risk near communities, land managers at the workshop worried about how global warming might impact ecological niches for various species. For example, some wonder whether the 1.9 million acres of southwestern pinyon pine devoured by beetles in 2003 will rebound into comparable pinyon-juniper stands, or be replaced by something else.

Invasive species and other colonizers

"A rapidly changing climate favors those species that can make rapid transitions," warned Kathryn Thomas of the U.S. Geological Survey's Southwest Biological Science Center. Following this logic, global warming might favor invasive species.

Thomas is just starting a five-year research project to document what's happening with invasives regionally. A survey of land managers found about half of them unsure whether "weeds" were increasing or decreasing, with the other half roughly split between the two options. More than 115 different alien invasive plants have been reported in the Southwest, and 88 of these thrive in woodlands, she said.

Ecologists and bioclimatologists agree that global warming would be expected to shuffle species around as their various habitats move north or south, or up or down a mountain. Neilson's modeling work, for example, points to large-scale expansion of woodlands at the expense of grasslands. For instance, live shrub oak and a variety of other species currently limited by frost could find their habitat had expanded up and over the Mogollon Rim.

Land managers are already reporting an ongoing "woody encroachment" of southwestern grasslands by mesquite trees and other woody plants. While woodlands expand into grasslands, grasslands could replace some southwestern deserts, according to Neilson's modeling results.

Land managers will face tough decisions about whether a plant is an invasive or

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Warming, continued

the rightful inhabitant of a new niche as the climate warms, Thomas and Neilson agreed.

"Do you protect the species that would be outcompeted in the Great Basin and hold that tide back? Or do you foster diversity—isn't diversity good?" Neilson asked.

Carbon dioxide fertilization

The influence of carbon dioxide on the plants themselves adds to the uncertainty about what the change will bring. The main greenhouse gas behind global warming, carbon dioxide (CO_2), is also an essential building block of plant tissue.

"There's no controversy over the fact that CO_2 levels are rising," noted Bruce Kimball, research leader at the U.S. Department of Agriculture's Maricopa facility between Phoenix and Tucson. "There would be some changes going on out there in natural ecosystems whether or not global warming was going on."

For decades, Kimball has been involved in testing how various plants respond to the increased rates of carbon dioxide in the atmosphere using an elaborate system of pipes and computers. The system maintains carbon dioxide levels in an open field at about 1½ times background levels. He and his colleagues have consistently found an increase in photosynthesis that translates into higher plant biomass.

Biomass typically increased by about 25 to 30 percent under the elevated carbon dioxide in woody species like cotton and grape, he noted, and by about 75 percent in sour orange trees.

In general, trees seem to respond better than grasses to elevated carbon dioxide rates, especially if precipitation rates increase, according to a 2004 *New Phytologist* paper Kimball recommended by Robert Novak and colleagues. This difference could be encouraging woody encroachment, although, again, other factors are involved.

Along with improving growth, elevated carbon dioxide levels improve a plant's water use efficiency. This factor could make a big difference in how the Southwest fares under climate change.

Output from Neilson's vegetation models considering potential niches for about 45 types of vegetation showed that the improvements in the water use efficiency rate as expected under rising carbon dioxide levels could dictate whether the U.S. West greens up or becomes more barren with global warming. The extent of the warming and potential changes in precipitation also would make a difference.

Immediacy in the message

Given the enormous risks at hand, one might ask why Americans, who as a nation produce a quarter of worldwide carbon dioxide emissions, won't sign on to an international effort to slow down the rate of global warming.

UA Environmental Psychology Professor Terry Daniel has a few hypotheses about why many people remain unconcerned. For instance, research indicates that in the human mind, "global" translates into "that's happening somewhere else." Meanwhile "Everybody is exposed," translates into "Nobody is exposed."

Also, scientists and society need to convey a specific course of action to take, not just report gloom and doom. It's difficult to be afraid of something abstract, and even more difficult to think about it if there's no solution in sight, he suggested.

When people understand global warming is happening in their own back yard, or affecting their favorite plant or animal or community, that's when they'll move to act, Daniel theorized. In short, if scientists want people to become concerned, they need to convince them that global warming is not a century away—it's here and now.

Melanie Lenart is a postdoctoral researcher with the Climate Assessment for the Southwest.

Resources on the Web

- The IPCC provides its reports and other background information at: http://www.ipcc.ch/index.html
- The National Climatic Data Center provides instrumental data at a variety of scales at: http://www.ncdc.noaa.gov/oa/climate/research/cag3/cag3.html
- To see how the current warming compares to 1,000-year temperature records reconstructed from tree rings and other archives, go to page 4 at the following link: http://www.ltrr.arizona.edu/trt/20040302.pdf
- Monthly data on atmospheric carbon dioxide measurements collected by Charles Keeling and colleagues since 1958 are available at: http://cdiac.esd.ornl.gov/ftp/trends/co2/maunaloa.co2
- For more on the Mapped Atmosphere-Plant-Soil System (MAPSS) project, see: http://www.fs.fed.us/pnw/corvallis/mdr/mapss/
- Also, a 12-page background document providing some MAPSS results is available at: http://www.fs.fed.us/pnw/pubs/science-update-6.pdf
- For more on Kathryn Thomas' invasive plant project, see the Southwest Exotic Plant Information Clearinghouse at the following website: http://www.usgs.nau.edu/SWEPIC/index.html

Temperature (through 2/16/05)

Sources: Western Regional Climate Center, High Plains Regional Climate Center

Average temperatures since October 1, 2004 have ranged from the upper 20s (degrees Fahrenheit) in north-central New Mexico to the mid-60s in southwestern Arizona (Figure 1b). These values are above-average, except in northwestern Arizona and along a short portion of the Colorado River (Figure 1a). Warmer-than-average conditions have also persisted over most of the Southwest during the past 30 days (Figures 1c–d). Northern portions of both states are generally 3–9 degrees F above average.

The Albuquerque National Weather Service (NWS) reports that the average January temperature of 41.7 degrees F was 6 degrees warmer than average, which is the third warmest January since 1931. The trend has continued in the first two and a half weeks of February; the Albuquerque temperature is 2.4 degrees F above average. In Flagstaff, Arizona, January was 7 degrees F warmer than average (Flagstaff NWS). Two negative aspects of the warmer temperatures are that snow melt occurs more rapidly and a greater proportion of precipitation has fallen as rain, resulting in faster runoff.

Figure 1a. Water year '04–'05 (through February 16, 2005) departure from average temperature.

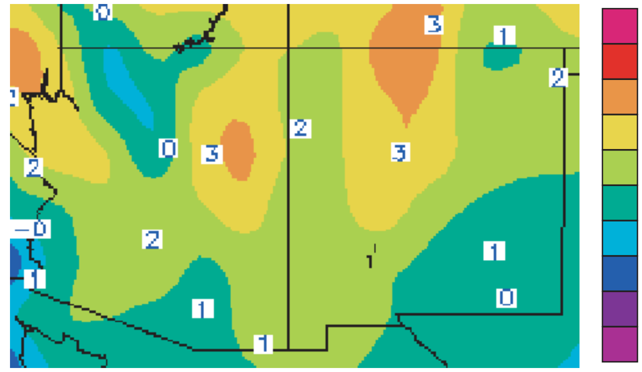


Figure 1b. Water year '04–'05 (through February 16, 2005) average temperature.

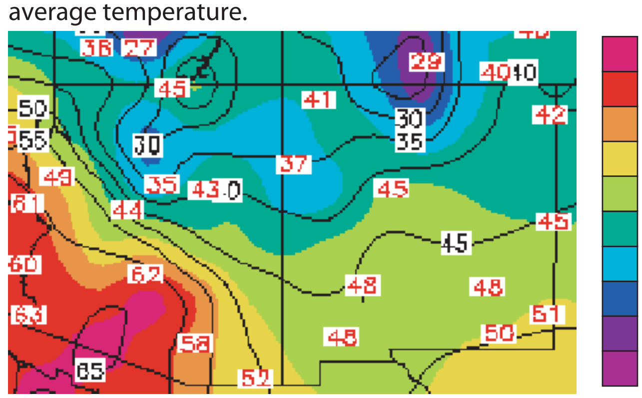


Figure 1c. Previous 30 days (January 18–February 16, 2005) departure from average temperature (interpolated).

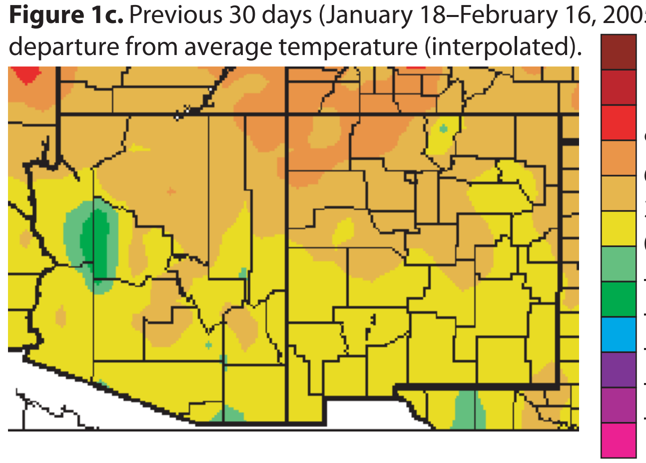
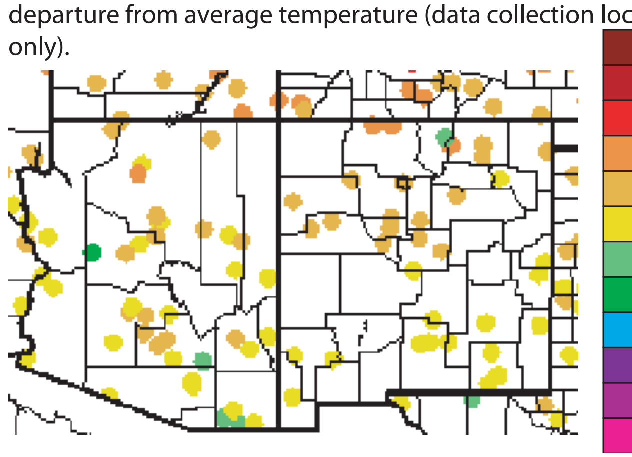


Figure 1d. Previous 30 days (January 18–February 16, 2005) departure from average temperature (data collection locations only).



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.

Figures 1c and 1d are experimental products from the High Plains Regional Climate Center.

On the Web:

For these and other temperature maps, visit:
http://www.wrcc.dri.edu/recent_climate.html and
http://www.hprcc.unl.edu/products/current.html

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

Precipitation (through 2/16/05)

Source: High Plains Regional Climate Center

Precipitation has been above average for nearly the entire Southwest since October 2004 (Figures 2a–b). Portions of western Arizona and central New Mexico have received at least 150 percent of average precipitation. Slightly drier-than-average conditions persist in parts of southeastern Arizona and west-central and north-central New Mexico. The wet trend has continued over the past 30 days (Figures 2c–d). Precipitation in the entire Southwest has been near or above average since mid-January. In New Mexico, some areas are in excess of 400 percent of average precipitation. According to the Albuquerque National Weather Service (NWS), the city received 1.38 inches of precipitation in January (0.89 inches above average), which ranks as the second wettest January since records began in 1892. January precipitation in Tucson was above-average for the first time in four years. It was only the second above-average January since 1995 (Tucson NWS). Eighteen other stations in southeastern Arizona had January precipitaion ranking in the top 10. Excessive precipitation, however, resulted in floods (CNN, February 13 and *Eastern Arizona Courier* February 16) and recreation area closures (*East Valley Tribune*, January 27).

Figure 2a. Water year '04–'05 through February 16, 2005 percent of average precipitation (interpolated).

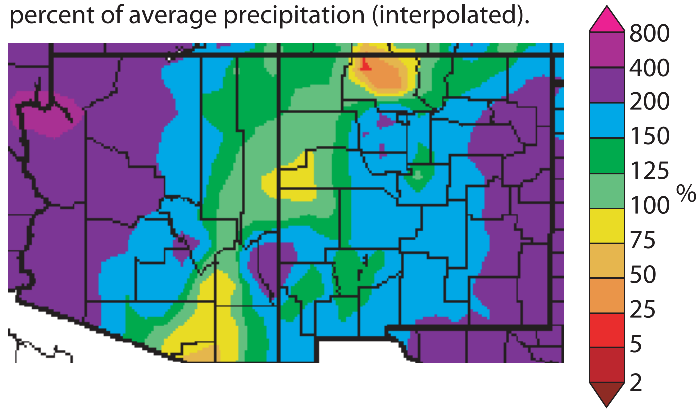


Figure 2b. Water year '04–'05 through February 16, 2005 percent of average precipitation (data collection locations only).

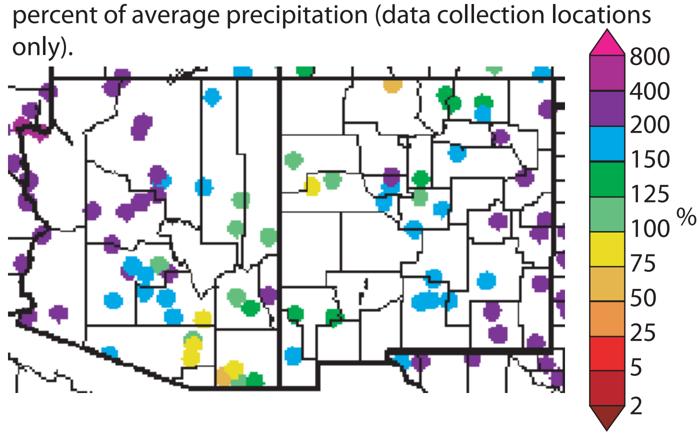


Figure 2c. Previous 30 days (January 18–February 16, 2005) percent of average precipitation (interpolated).

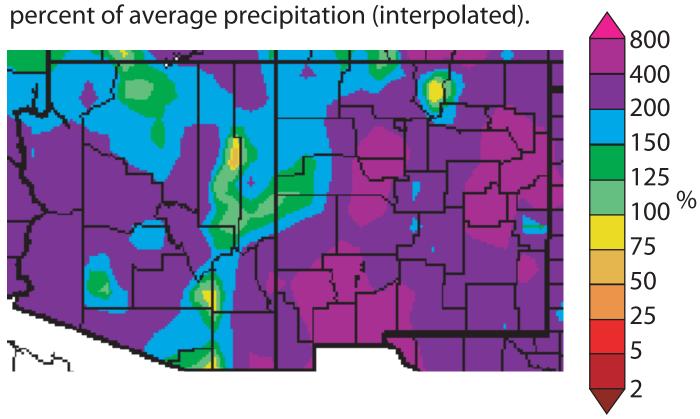
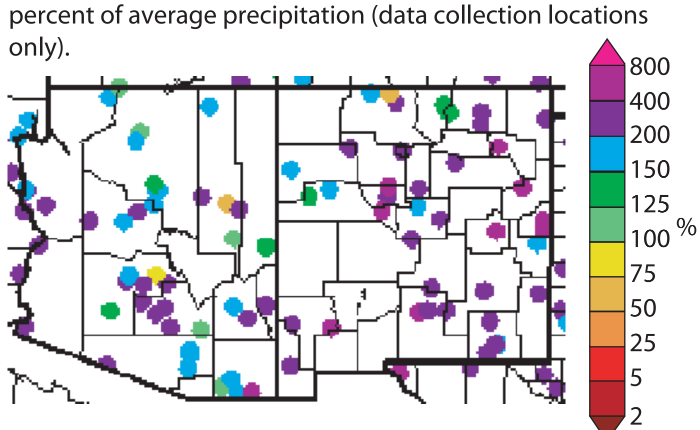


Figure 2d. Previous 30 days (January 18–February 16, 2005) percent of average precipitation (data collection locations only).



Notes:

The water year begins on October 1 and ends on September 30 of the following year. As of October 1, 2004 we are in the 2005 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

U.S. Drought Monitor

(released 2/17/05)

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

Drought intensity eased across much of Arizona and New Mexico since last month (Figure 3) due to above-average precipitation in the Southwest. Following steady improvement over the past few months, small portions of extreme northwestern and west-central Arizona and additional sections of eastern New Mexico are no longer considered to be in drought. Drought status decreased to abnormally dry for the western half of Arizona. According to the National Oceanic and Atmospheric Climate Prediction Center, this marks the first time since March 2002 that drought status has been this low. Since December 2004, southeastern Arizona and southwestern New Mexico drought status decreased from extreme to moderate. Only far northeastern Arizona and a strip of northern New Mexico stretching from the Arizona border halfway across the state remain in extreme drought.

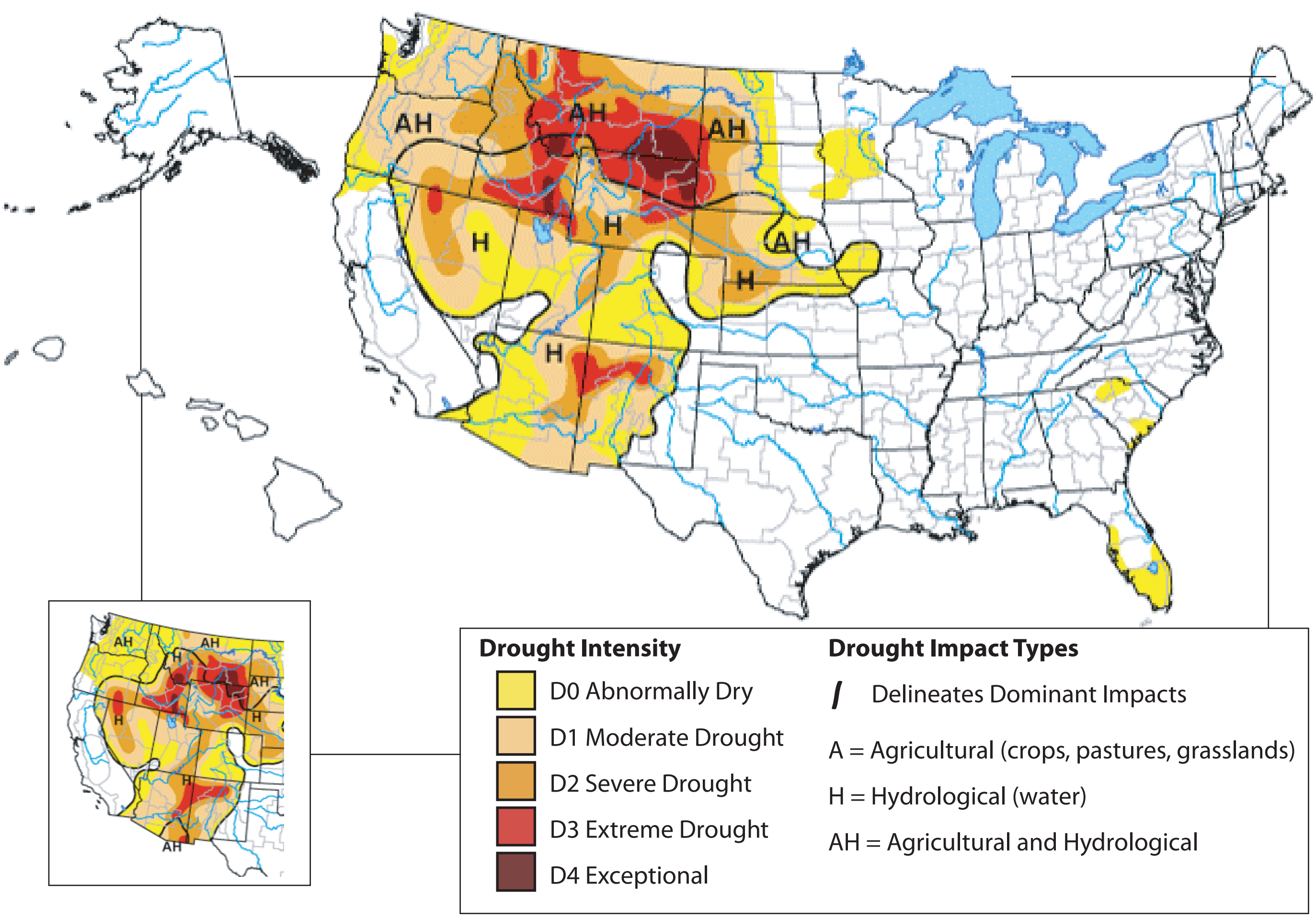
Despite the continuing improvement, water use remains an important topic in the region. The House Committee on Natural Resources and Agriculture recently voted to allow city and county governments to limit or refuse new development based on water supply, although several groups oppose the decision (*Arizona Republic*, February 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 Michael Hayes, NDMC.

Figure 3. Drought Monitor released February 17, 2005 (full size) and January 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 1/14/05)

Source: New Mexico Natural Resources Conservation Service

Since early December 2004, long-term drought conditions improved in much of New Mexico, but extreme or emergency drought status persists in west-central parts of the state (Figure 4b). Precipitation has been above average over the past 30 days and generally near average to above average for the water year (see Figure 2). The Albuquerque National Weather Service says that while the precipitation deficit has decreased, it still exists; recent rain and snow is moving the state in the right direction (*Albuquerque Tribune*, February 16).

In late January, Albuquerque began treating contaminated groundwater to eventually be used in the environment, which will conserve other water sources (*Albuquerque Tribune*, February 16). Albuquerque is rewarding residents for water conservation by mailing 1000 movie passes to residents who have reduced water use through conservation programs (*The New Mexico Channel*, February 1). Ute Water Project officials hired consultants to determine the impact on agricultural and water wells if the project is not completed (*Portales News-Tribune*, February 17). Cimarron in northern New Mexico recently began work on a diversion project that will supply a more reliable source of water (*New Mexico Business Weekly*, February 10). Low water supply in an older well and a new well not providing the expected water has led Chupadero in north-central New Mexico to request $150,000 to replace the water system (*Albuquerque Journal*, February 14).

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.water.az.gov/gdtf/

Figure 4a. Short-term drought map based on meteorological conditions as of January 14, 2005.

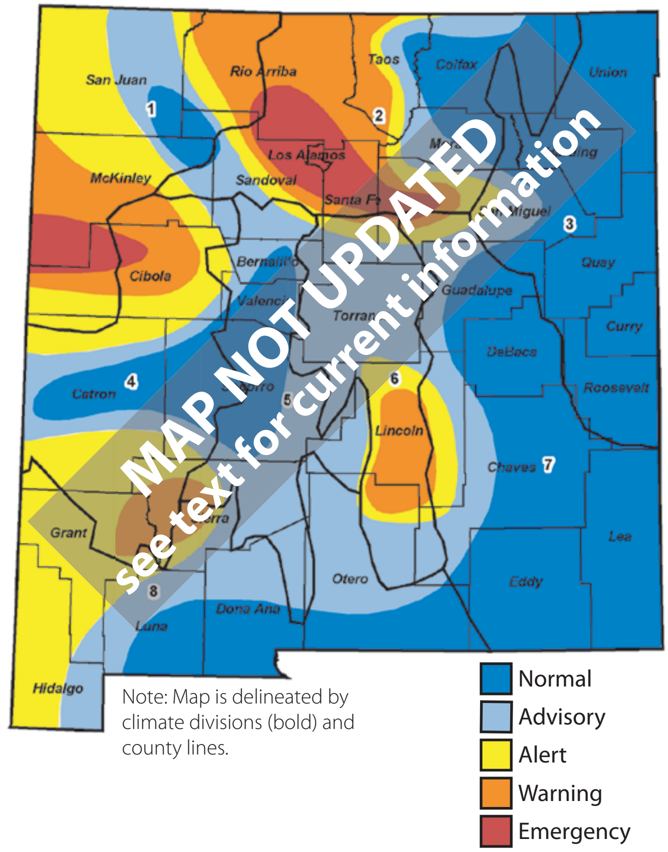
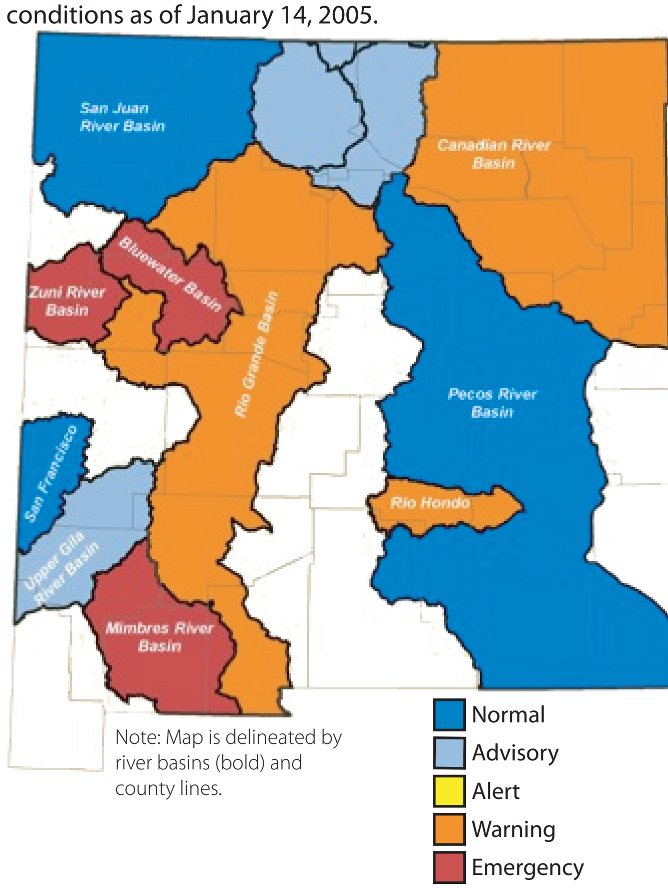


Figure 4b. Long-term drought map based on hydrological conditions as of January 14, 2005.



Arizona Reservoir Levels

(through 1/31/05)

Source: National Water and Climate Center

Many Arizona reservoirs remain well below maximum capacities, despite increases in storage (Figure 5). Two reservoirs had greater than 10 percent of capacity increases—the Salt River System (13 percent) and Show Low Lake (35 percent). While San Carlos Lake storage increased by 6 percent, it is still below 10 percent full. The only reservoirs to experience a decrease were Lake Havasu and Lake Powell. As of the end of January, Lake Powell was at 35 percent of capacity, which represents a 1 percent decrease since the end of December. This monthly downward trend has been occurring since May 2004. The lake is now at its lowest level since May 12, 1969, when storage was 8,440,190 acre-feet during the initial filling of the reservoir. Lakes Powell and Mead are the only two Arizona reservoirs at lower levels compared to January 2004 (not shown). The total storage of all reservoirs in the state is about 60 percent of capacity or about 5 percent below average (Natural Resources Conservation Service, February 1). Lake Powell accounts for much of this deficit. Some experts believe that Lake Powell will continue to drop several more feet during in the coming months before receiving late spring snowmelt runoff (KSL-TV, February 11).

Salt River Project (SRP) officials recently announced that they will make full water deliveries for farms and homes due to recent increases in the Salt River Reservoir System (*Tucson Citizen*, February 8, and *East Valley Tribune*, February 9). SRP hydrologists forecast a 580 percent increase in runoff compared to last year, which is expected to increase system capacity by 48 percent.

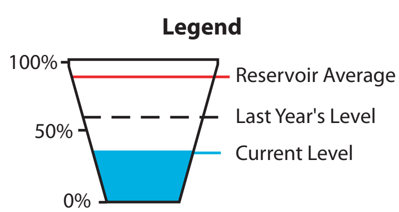
Notes:

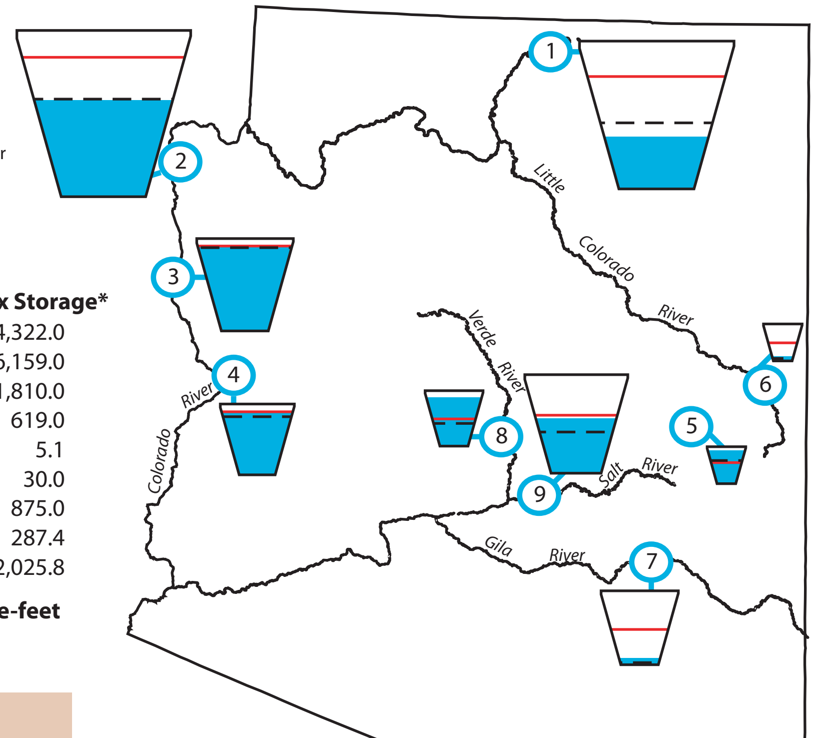
The map gives a representation of current storage levels for reservoirs in Arizona. Reservoir locations are numbered within the blue circles on the map, corresponding to the reservoirs listed in the table. The cup next to each reservoir shows the current storage level (blue fill) as a percent of total 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 (red line) and the 1971–2000 reservoir average (dotted 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 January 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	35%	8,481.0	24,322.0
2. Lake Mead	58%	15,119.0	26,159.0
3. Lake Mohave	92%	1,658.7	1,810.0
4. Lake Havasu	90%	558.5	619.0
5. Show Low Lake	90%	4.6	5.1
6. Lyman Reservoir	13%	3.8	30.0
7. San Carlos	9%	83.0	875.0
8. Verde River System	88%	251.6	287.4
9. Salt River System	56%	1141.9	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 1/31/05)

Source: National Water and Climate Center

Only two reservoirs in New Mexico did not report increases—Heron Lake, which remained steady, and Lake Abiquiu, which decreased by 200 acre-feet (Figure 6). Navajo Reservoir, the second largest lake in the state, continued to have both the most storage and the highest percent of capacity (61 percent). Lake Avalon had the greatest increase in capacity (13 percent). Many New Mexico reservoirs are at or above last year's levels, except for El Vado (2 percent lower) and Costilla (3 percent lower). The USDA-Natural Resources Conservation Service (NRCS) reports that total reservoir storage in many western U.S. states is below average (February 1). New Mexico statewide storage is half of its average.

The forecast for reservoir levels in New Mexico is promising. Although the level of Heron Lake has dropped by nearly 60 feet in the past three years, according to a study by the Friends of Heron Lake, the U.S. Bureau of Reclamation predicts an increase of approximately 30 feet (KRQE-TV, February 3). The NRCS is reporting above-average snowpack in the Upper Rio Grande Basin in Colorado and in the San Juan, Pecos River, and Rio Grande basins in New Mexico (KOBT, February 8). As the snow melts, the runoff will increase water levels in the basins' reservoirs.

Officials in Tucumcari plan to replace a city drainage system by constructing a new retention pond for storm-water runoff (*Quay County Sun*, January 28). The retention pond would hold the water for less than 36 hours and would include a filtering system to remove hazardous chemicals before draining into Tucumcari Lake.

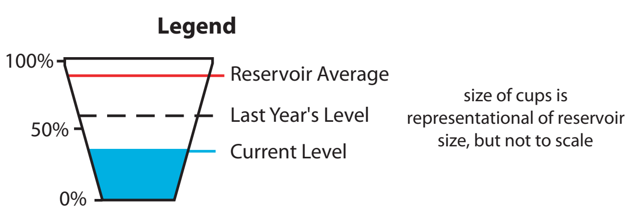
Notes:

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 (red line) and the 1971–2000 reservoir average (dotted 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.

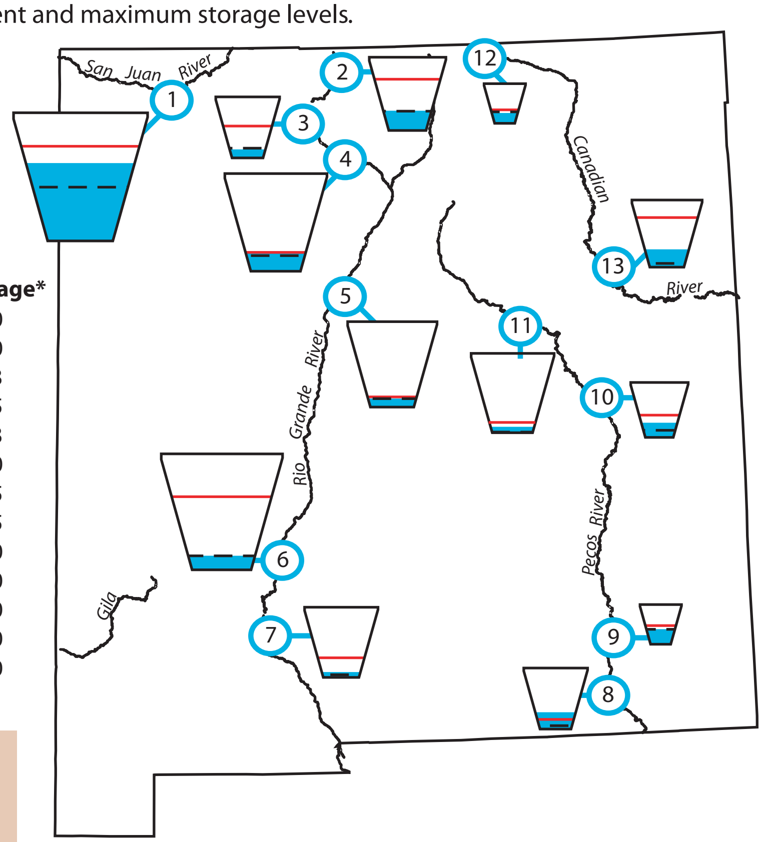
These data are based on reservoir reports updated monthly by the National Water and Climate Center of the U.S. Department of Agriculture's Natural Resource Conservation Service. For additional information, contact Tom Pagano at the National Water Climate Center (tpagano@wcc.nrcs.usda.gov; 503-414-3010) 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 January 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	61%	1027.9	1,696.0
2. Heron	27%	109.5	400.0
3. El Vado	14%	25.5	186.3
4. Abiquiu	20%	111.5	554.5
5. Cochiti	10%	49.9	502.3
6. Elephant Butte	12%	239.8	2,065.0
7. Caballo	8%	26.4	331.5
8. Brantley	28%	41.6	147.5
9. Lake Avalon	38%	2.3	6.0
10. Sumner	27%	27.5	102.0
11. Santa Rosa	7%	31.5	447.0
12. Costilla	26%	4.2	16.0
13. Conchas	26%	65.1	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

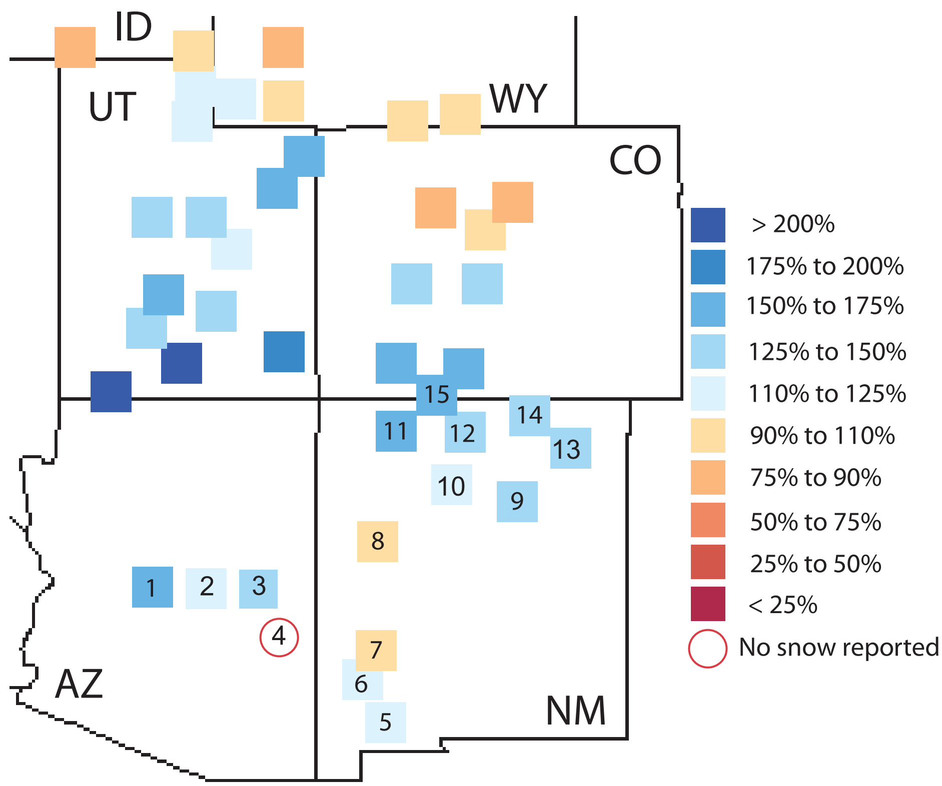
(updated 2/17/05)

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

Snow water content (SWC) is above average throughout much of the Southwest and the Colorado River Basin (Figure 7). The average statewide SWC in Arizona and New Mexico are about 130 percent of average. The highest values in the West are in southern Utah, where SWC is greater than 200 percent of average. The Gila and Zuni/Bluewater river basins in New Mexico and basins in southern Idaho, southern Wyoming, and northern Colorado show near- to slightly below-average SWC. Regionwide, SWC has generally declined in the northern river basins, while southern sections have remained steady or improved slightly since mid-January.

The series of storm systems that have impacted the West in 2005 are the main contributors to the above-average snowpack and SWC. A late January storm dropped up to 18 inches of snow in parts of north-central New Mexico according to the Albuquerque National Weather Service (NWS). The Albuquerque NWS also reports that snowpack in the Rio Grande Basin in New Mexico is the third highest since 1995. Hydrologists believe that the melt from the above-average snowpack in the Rocky Mountains may result in a 50-foot water level increase at Lake Powell during the spring and summer, 10 times higher than in 2004 (*Arizona Republic*, February 16).

Figure 7. Average snow water content (SWC) in percent of average for available monitoring sites as of February 17, 2004.



Arizona Basins
1 Verde River Basin
2 Central Mogollon Rim
3 Little Colorado - Southern Headwaters
4 Salt River Basin

New Mexico Basins
5 Mimbres River Basin
6 San Francisco River Basin
7 Gila River Basin
8 Zuni/Bluewater River Basin
9 Pecos River
10 Jemez River Basin
11 San Miguel, Dolores, Animas, and San Juan River Basins
12 Rio Chama River Basin
13 Cimarron River Basin
14 Sangre de Cristo Mountain Range Basin
15 San Juan River Headwaters

Notes:

Snowpack telemetry (SNOTEL) sites are automated stations that measure snowpack depth, temperature, precipitation, soil moisture content, and soil saturation. A parameter called snow water content (SWC) 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 in Arizona and New Mexico, based on SNOTEL sites in or near the basins, compared to the 1971–2000 average values. Data for Utah, Colorado, and parts of Wyoming and Utah are also shown, since these states contribute to runoff and streamflow in the Colorado River basin. 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.

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

Temperature Outlook
(March–August 2005)
Source: NOAA Climate Prediction Center

The NOAA-Climate Prediction Center (CPC) seasonal temperature outlooks through August show increased chances of warmer-than-average conditions through the Southwest and along the West Coast (Figures 8a–d). Arizona and the Lower Colorado River Basin continue to have the highest probabilities. Below-average temperatures are predicted for the south-central United States from March–June (Figure 8a–b) and for the north-central United States from May–August (Figures 8c–d). The CPC expects only minimal El Niño influence on temperatures after May. After the March–May period, the outlook is based mainly on long-term trends. In addition, the CPC decreased the probabilities of warmer-than-average March–May conditions in the Southwest to be consistent with above-average March–May precipitation forecasts.

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 March–May 2005.

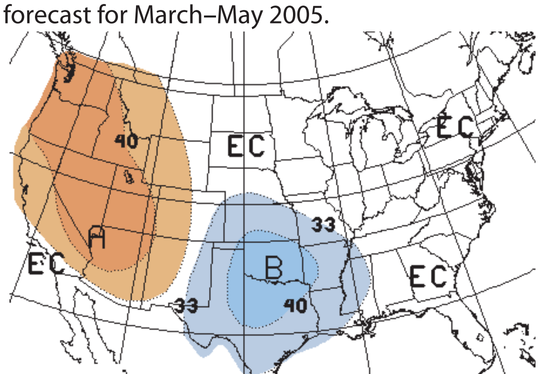


Figure 8b. Long-lead national temperature forecast for April–June 2005.

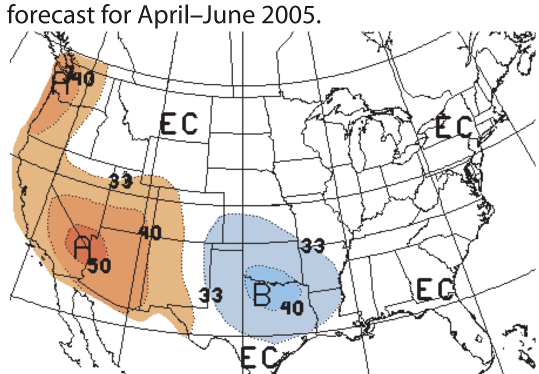


Figure 8c. Long-lead national temperature forecast for May–July 2005.

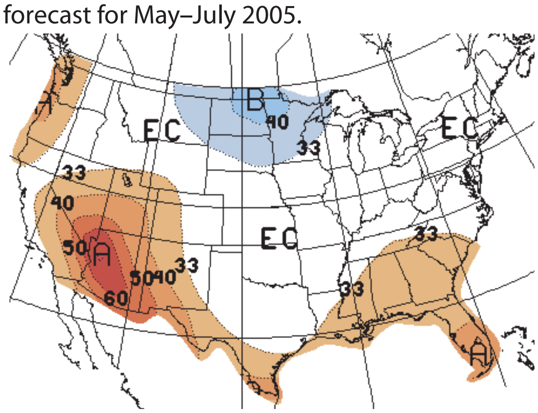
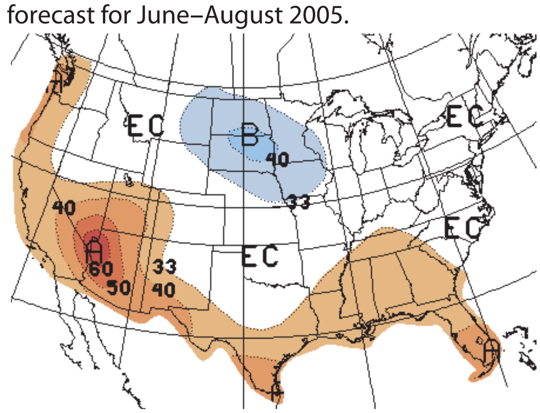


Figure 8d. Long-lead national temperature forecast for June–August 2005.



A= Above
- 60.0–69.9%
- 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.

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

(March–August 2005)

Source: NOAA Climate Prediction Center

The NOAA-CPC seasonal precipitation outlook for March–May indicates increased chances of wetter-than-average conditions from southern California to the southwestern Great Lakes (Figure 9a). The highest probabilities are mainly in Arizona and New Mexico. The CPC predicts increased chances of below-average precipitation in the Pacific Northwest during this period. The only other forecasted anomalies through late summer are drier-than-average conditions in the northern Great Basin from June–August (Figure 9d). The March–May outlook (Figure 9a) is based on consistent output from statistical and dynamical models, as well as typical El Niño impacts. For most of the United States, subsequent periods (Figures 9b–d) are designated Equal Chances (EC), as an already weak El Niño is predicted to continue to wane, and model forecasts for summer lack consistency.

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 March–May 2005.

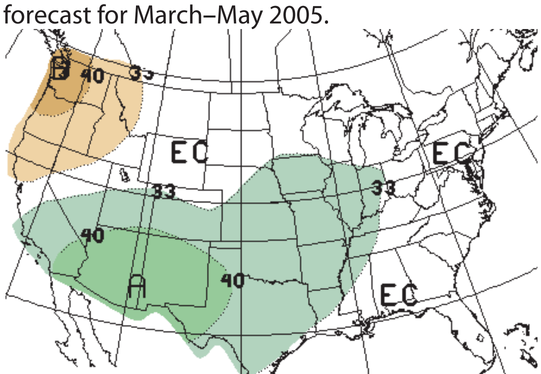
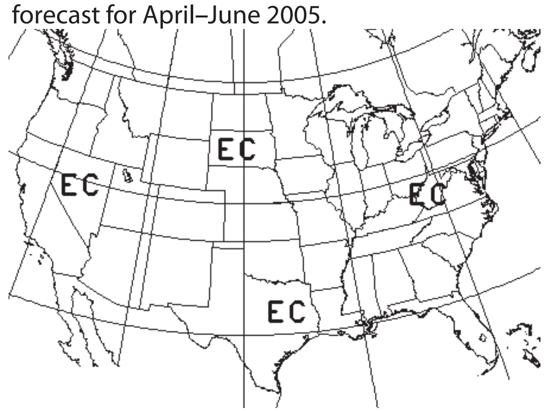


Figure 9b. Long-lead national precipitation forecast for April–June 2005.



A= Above: 40.0–49.9%; 33.3–39.9%

B= Below: 33.3–39.9%; 40.0–49.9%

EC= Equal chances. No forecasted anomalies.

Figure 9c. Long-lead national precipitation forecast for May–July 2005.

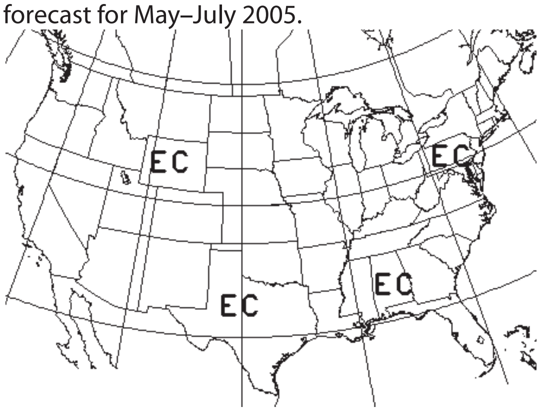
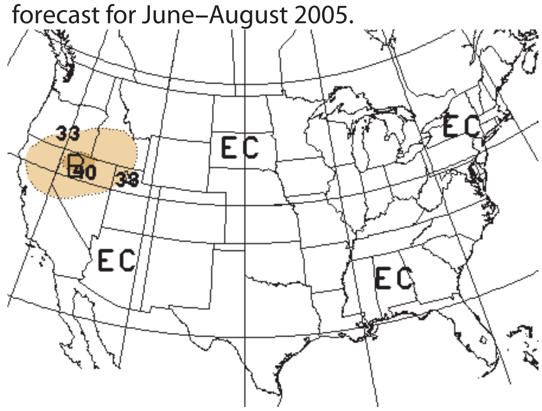


Figure 9d. Long-lead national precipitation forecast for June–August 2005.



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 May 2005)

Sources: NOAA Climate Prediction Center

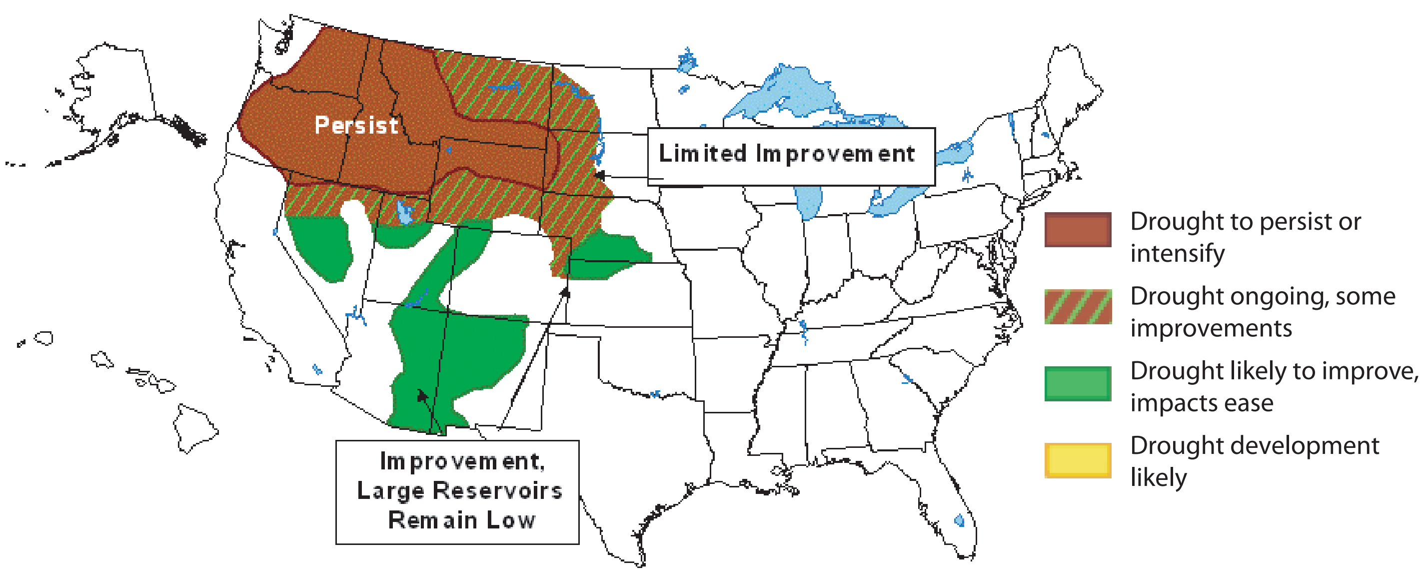
The NOAA-Climate Prediction Center (CPC) seasonal drought outlook through May (Figure 10) shows that improvements are likely in the Southwest, although large reservoirs are expected to remain low. The January product (not shown) correctly forecasted the improvement in western Arizona. Northwestern New Mexico is likely to see improvement in the coming months. Nearly the entire Southwest received above-average precipitation in the past 30 days (see Figure 2), which contributed to the improving conditions. The CPC forecast through May predicts increased chances of above-average precipitation for the region (see Figure 9). Except for locations from the Northwest coast to western South Dakota, the remainder of the western United States should see limited improvements during the winter and spring. As predicted in January, drought did develop or intensify in portions of Oregon, Washington, Idaho, and Montana (see Figure 3) due to below-average precipitation (less than 50 percent of average) in the past 30 days.

Localities and states around the West continue to focus on resource issues. Tucson water officials believe that water demand by 2020 could exceed supply from the Central Arizona Project and groundwater allowances unless treated effluent water is added to drinking reserves (*Tucson Citizen*, February 7). Arizona Representative Tom O'Halleran is working on 13 conservation and drought management bills to aid rural Arizonans (*Tri-Valley Central*, February 1). As part of New Mexico's capital project budget, Governor Bill Richardson wants to set aside $10 million to buy land and the related water rights along the Pecos River (*Santa Fe New Mexican*, February 15). In Colorado, leaders of 27 Front Range cities agreed upon a contract to conserve existing supplies before they seek water from the western slope of the Rockies and eastern Colorado farms (*U.S. Water News*, February 2005).

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 May 2005 (release date February 17, 2005).



On the Web:

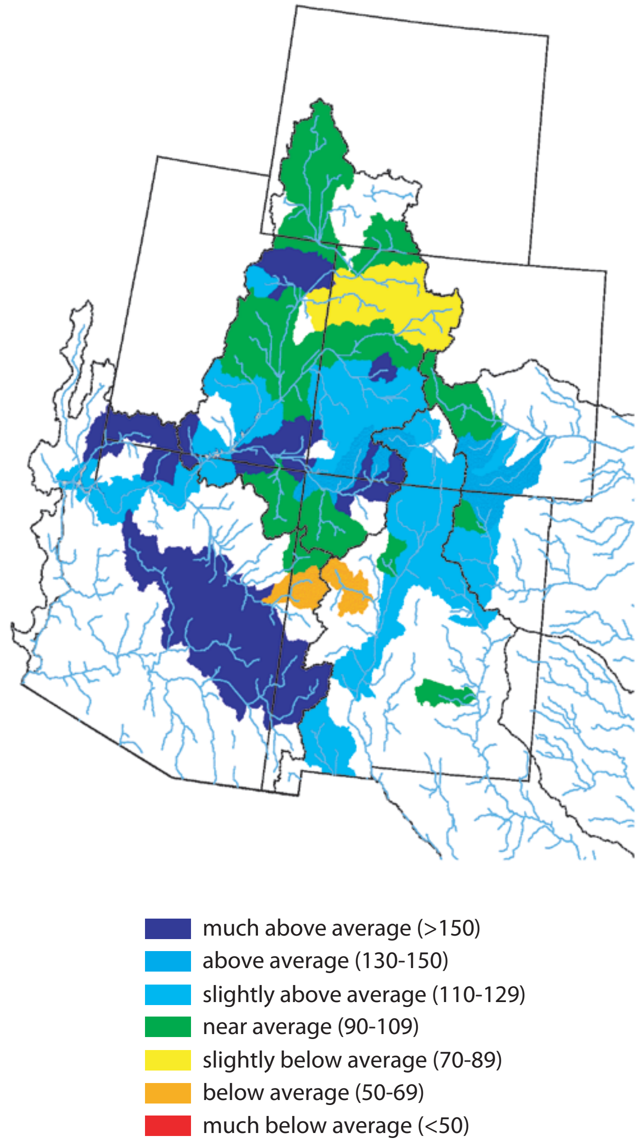
For more information, visit:
http://www.drought.noaa.gov/

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

Most streams in the Colorado River Basin are expected to have near-average to well above-average flow through the summer (Figure 11). Arizona, New Mexico, southwestern Colorado, and southern Utah have the highest probabilities of above-average streamflow, while chances are lower in the northern basin. Below-average streamflow is predicted for portions of east-central Arizona and west-central New Mexico, where extreme drought persists (see Figure 3). Compared to the January 1 forecasts (not shown), the current predictions are for higher percentages of average streamflow across much of the region.

The extent of snowpack, snow water content, and soil moisture are among the variables that affect runoff. If these factors continue to change, then streamflow forecasts will undergo greater adjustments than are typically seen later in the season. The amount, intensity, and form of precipitation (liquid or frozen) and temperature influence streamflow. Autumn rain in the mountains increased soil moisture; consequently, future snowmelt can more easily reach streams, rather than being absorbed by the soil (KOTBV, February 2). Although precipitation outlooks indicate increased chances of above-average precipitation through March in the Southwest (see Figure 9), increased chances of above-average temperatures are expected through the summer (see Figure 8). Warmer temperatures can result in a greater proportion of precipitation falling as rain, rather than snow. Also, warmer temperatures cause snowfall to melt sooner, which can translate into lower late-spring streamflow. Both scenarios depend on the magnitude of temperature departures from average.

Figure 11. Spring and summer streamflow forecast as of February 1, 2005 (percent of average).



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

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

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

Notes:
The forecast information provided in Figure 11 is updated monthly by the National Water and Climate Center, part of the U.S. Department of Agriculture's Natural Resources Conservation Service. Unless otherwise specified, all streamflow forecasts are for streamflow volumes that would occur naturally without any upstream influences, such as reservoirs and diversions. The USDA-NRCS only produces streamflow forecasts for Arizona between January and April, and for New Mexico between January and May.

The NWCC provides a range of forecasts expressed in terms of percent of average streamflow for various statistical exceedance levels. The streamflow forecast presented here is for the 50 percent exceedance level, and is referred to as the most probable streamflow. This means there is at least a 50 percent chance that streamflow will occur at the percent of average shown in Figure 11.

El Niño Status and Forecast

Sources: NOAA Climate Prediction Center, International Research Institute for Climate Prediction

Sea surface temperatures (SSTs; not shown) and the Southern Oscillation Index (SOI; Figure 12b) continue to indicate a weak El Niño in the tropical Pacific Ocean. The International Research Institute for Climate Research (IRI) forecast shows a 65 percent chance that El Niño will continue through at least April or May; probabilities decrease thereafter (Figure 12a). Beginning with the July–September period and continuing into early 2006, neutral conditions are more likely. Probabilities for La Niña remain low through January 2006.

The IRI reports that SST anomalies in the tropical Pacific are located farther west than during a typical El Niño episode (*IRI Technical ENSO Update*, February 17). El Niño impacts on North American weather patterns tend to be weak when SST anomalies are located farther west. CPC points out that the much of the recent above-average precipitation in California and the Southwest is related to a persistent circulation pattern off of the West Coast of the United States that blocks storms from a more northern storm track and sends them to our region. According to the CPC, the Madden-Julian Oscillation has played a role in strengthening the subtropical jet stream and bringing precipitation to the Southwest during the past several months.

Figure 12a. IRI probabilistic ENSO forecast for El Niño 3.4 monitoring region (released February 17, 2005). Colored lines represent average historical probability of El Niño, La Niña, and neutral.

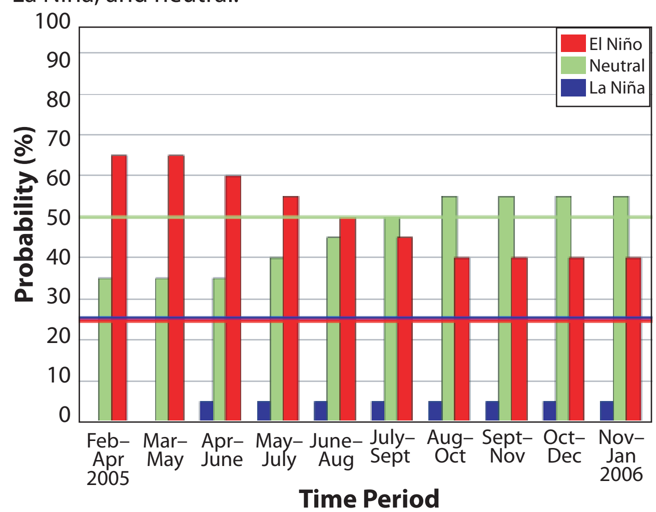
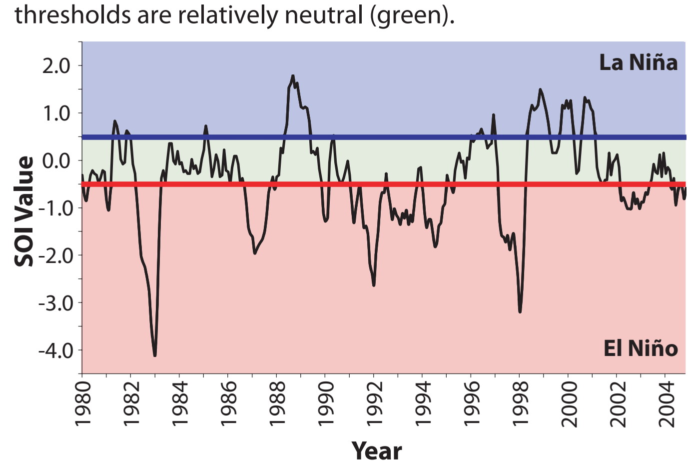


Figure 12b. The standardized values of the Southern Oscillation Index from January 1980–January 2005. La Niña/El Niño occurs when values are greater than 0.5 (blue) or less than -0.5 (red) respectively. Values between these thresholds are relatively neutral (green).



Notes:

Figure 12a 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.

Figure 12b shows the standardized three month running average values of the Southern Oscillation Index (SOI) from January 1980 through January 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.

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
(November 2004–January 2005)

Source: NOAA Climate Prediction Center

The forecast issued in October 2004 for November 2004–January 2005 indicated increased chances of above-average temperatures in the western United States, with highest probabilities in the Arizona, southern Nevada, southern California, and the Northwest (Figure 13a). The NOAA-CPC predicted increased chances of cooler-than-average conditions in portions of the south-central United States. The forecast verified well for most of the West, which exhibited above-average temperatures during the forecast period (Figure 13b). Portions of western and southern Arizona and eastern California, where the forecast indicated the highest probabilities of above-average temperatures, exhibited below-average observed temperatures. Elsewhere in the country, forecast performance was poorest in the south-central states, where below-average temperatures were predicted and above-average temperatures were observed.

Figure 13a. Long-lead U.S. temperature forecast for November 2004–January 2005 (issued October 2004).

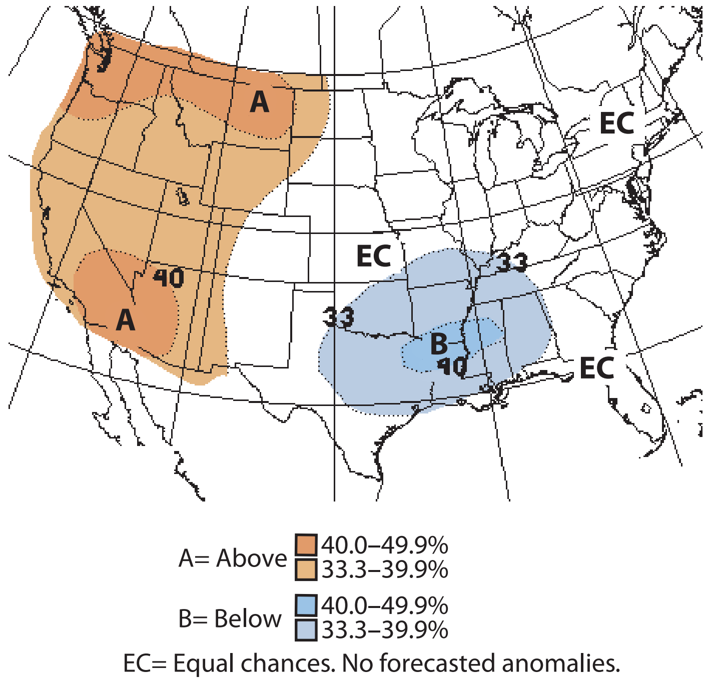
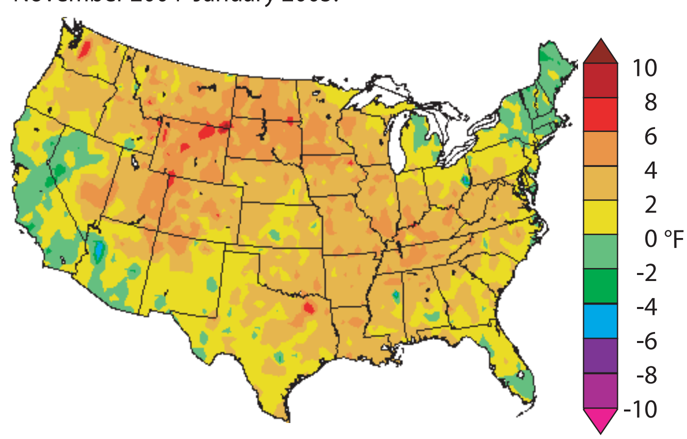


Figure 13b. Average temperature departure (in degrees F) for November 2004–January 2005.



Notes:

Figure 13a shows the NOAA Climate Prediction Center (CPC) temperature outlook for the months November 2004–January 2005. This forecast was made in October 2004.

The October–December 2004 NOAA CPC 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. Care should be exercised when comparing the forecast (probability) map with the observed temperature maps described below.

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 13b shows the observed departure of temperature (°F) from the average for November 2004–January 2005.

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
(November 2004–January 2005)
Source: NOAA Climate Prediction Center

The NOAA-CPC forecast for November 2004–January 2005 indicated increased chances of above-average precipitation in the south-central United States and increased chances of below-average precipitation in the Ohio River Valley (Figure 14a); no change in probabilities was forecasted for the Southwest and the rest of the contiguous United States. During much of the forecast period, the Southwest generally received well above-average precipitation (Figure 14b). Overall, the forecast verified well for Texas and the western Gulf Coast, which received above-average precipitation. However, contrary to expectations, the upper Ohio River Valley received above-average precipitation. The forecast performed poorly in this area, in part because the consistency of El Niño impacts decreases with ENSO strength and this winter's El Niño is categorized as weak.

Figure 14a. Long-lead U.S. precipitation forecast for November 2004–January 2005 (issued October 2004).

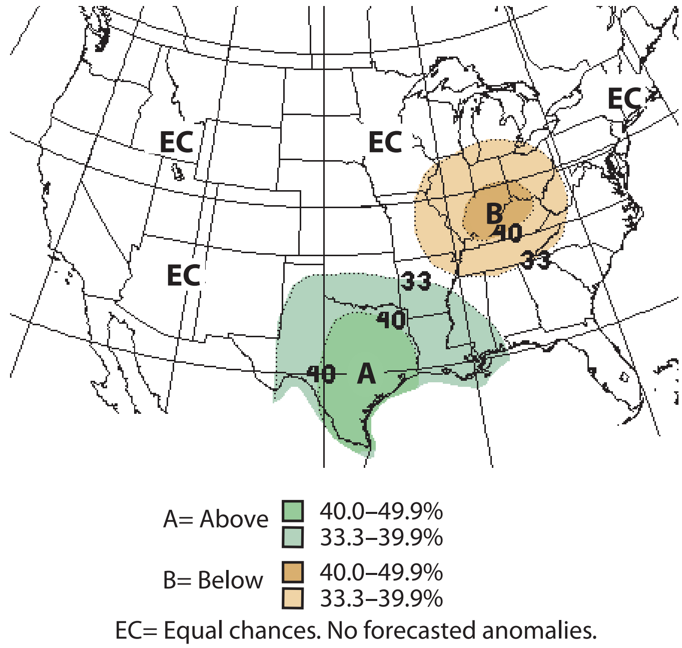
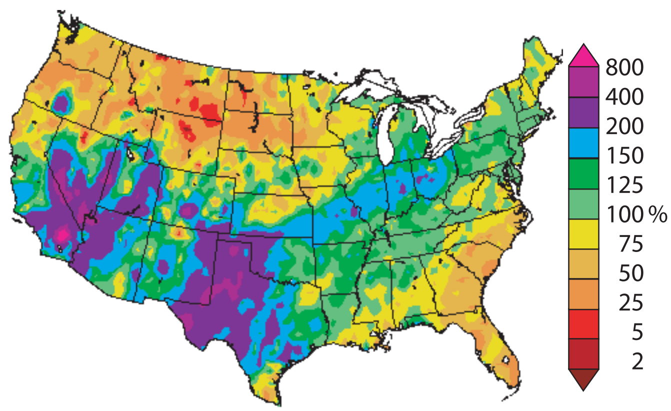


Figure 14b. Percent of average precipitation observed from November 2004–January 2005.



Notes:
Figure 14a shows the NOAA Climate Prediction Center (CPC) precipitation outlook for the months November 2004–January 2005. This forecast was made in October 2004.

The November 2004–January 2005 NOAA CPC 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. Care should be exercised when comparing the forecast (probability) map with the observed precipitation maps described below.

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 14b shows the observed percent of average precipitation observed November 2004–January 2005.

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