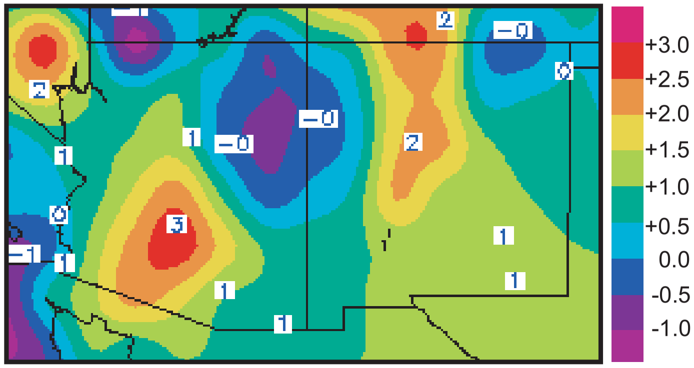
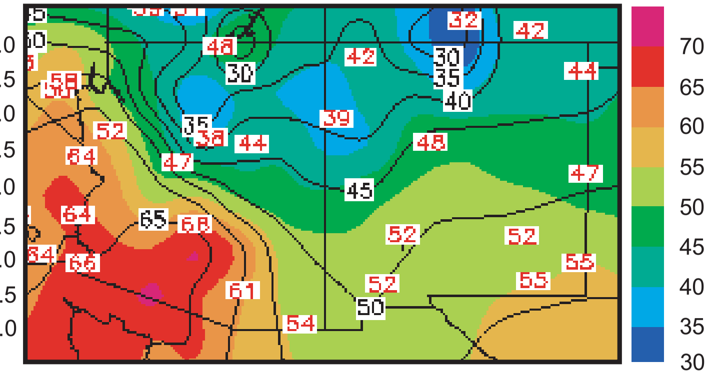
1. Recent Conditions: Temperature (up to 05/14/03) ♦ Source: Western Regional Climate Center

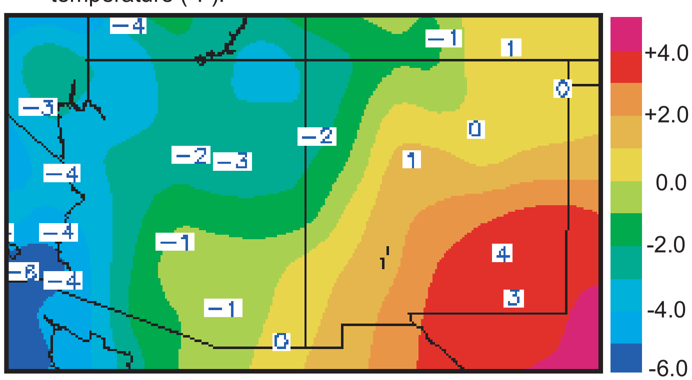
1a. Water year '02-'03 (through 5/14) departure from average temperature (°F).



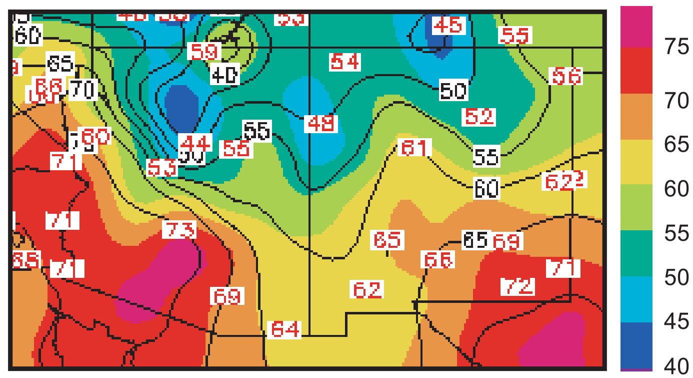
1b. Water year '02-'03 (through 5/14) average temperature (°F).



1c. Previous 28 days (4/17 - 5/14) departure from average temperature (°F).



1d. Previous 28 days (4/17 - 5/14) average temperature (°F).



Highlights: During the past month, there have been consistent below-average temperatures across western, central, and northeastern Arizona, as well as northwestern New Mexico (Figures 1c and 1d). Stations in southern and eastern New Mexico have reported consistently above-average temperatures during the last month. These effects are the result of cooler-than-average maximum temperatures across most of the region, combined with above-average minimum temperatures across almost all of New Mexico. During the past several weeks northern New Mexico continues to experience overnight freezing temperatures. Central and southern Arizona temperatures have been punctuated by intermittent below-average maximum temperatures. Large portions of our region (e.g., central and western Arizona) have displayed overall above-average temperatures, consistent with seasonal temperature outlooks. The recent warming in southern and eastern New Mexico is of concern to fire and range managers.

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

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

Notes:

The Water Year begins on October 1 and ends on September 30 of the following year. As of October 1, we are in the 2003 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 arithmetic mean of annual data from 1971-2000.

The data are in degrees Fahrenheit (°F).

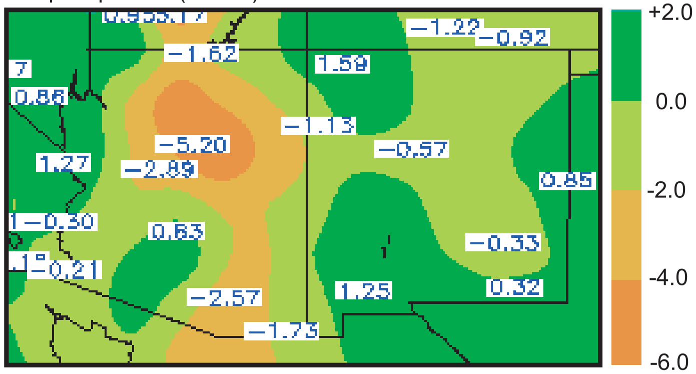
Departure from average temperature is calculated by subtracting current data from the average and can be positive or negative.

These maps are derived by taking measurements at meteorological stations (at airports) and estimating a continuous map surface based on the values of the measurements and a mathematical algorithm. This process of estimation also is called spatial interpolation.

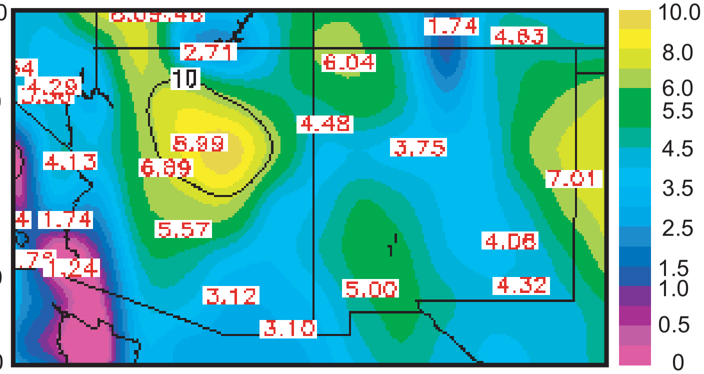
The red and blue numbers shown on the maps represent individual stations. The contour lines and black numbers show average temperatures.

2. Recent Conditions: Precipitation (up to 05/14/03) ♦ Source: Western Regional Climate Center

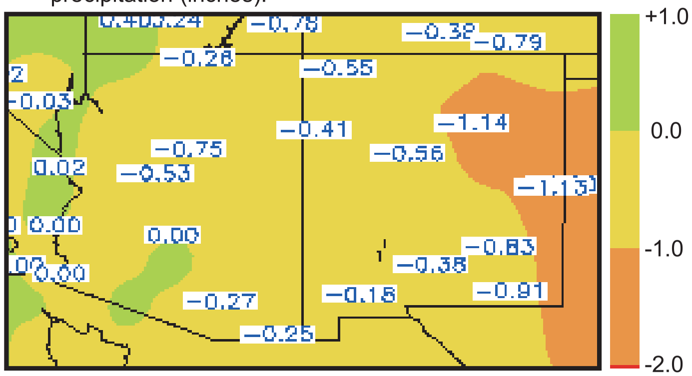
2a. Water year '02-'03 (through 5/14) departure from average precipitation (inches).



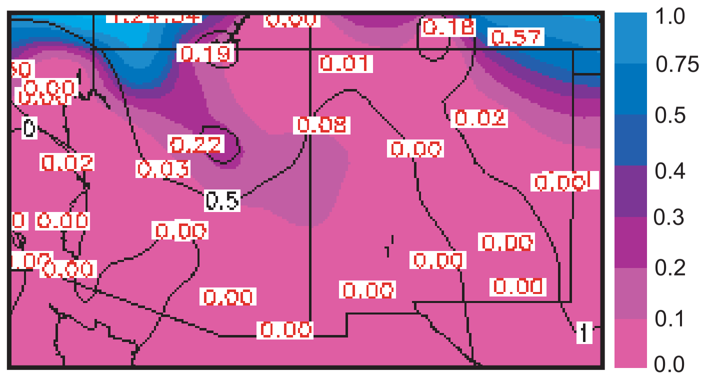
2b. Water year '02-'03 (through 5/14) total precipitation (inches).



2c. Previous 28 days (4/17 - 5/14) departure from average precipitation (inches).



2d. Previous 28 days (4/17 - 5/14) total precipitation (inches).



Highlights: Most of New Mexico and parts of western and central Arizona have received near-average to above-average precipitation since October 1, 2002 (Figure 2a). Water-year precipitation for northern and southeastern Arizona and along the Mogollon Rim has been below-average. During the past month our region has received virtually no precipitation (Figures 2c and 2d). The lack of precipitation in southeastern New Mexico, combined with above-average temperatures and strong winds during the first half of May, has raised concerns about soil erosion and poor range conditions.

For these and other precipitation maps, visit: http://www.wrcc.dri.edu/recent_climate.html

For National Climatic Data Center monthly and weekly precipitation and drought reports for Arizona, New Mexico and the Southwest region, visit: http://lwf.ncdc.noaa.gov/oa/climate/research/2002/perspectives.html

Notes:

The Water Year begins on October 1 and ends on September 30 of the following year. As of October 1, we are in the 2003 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.

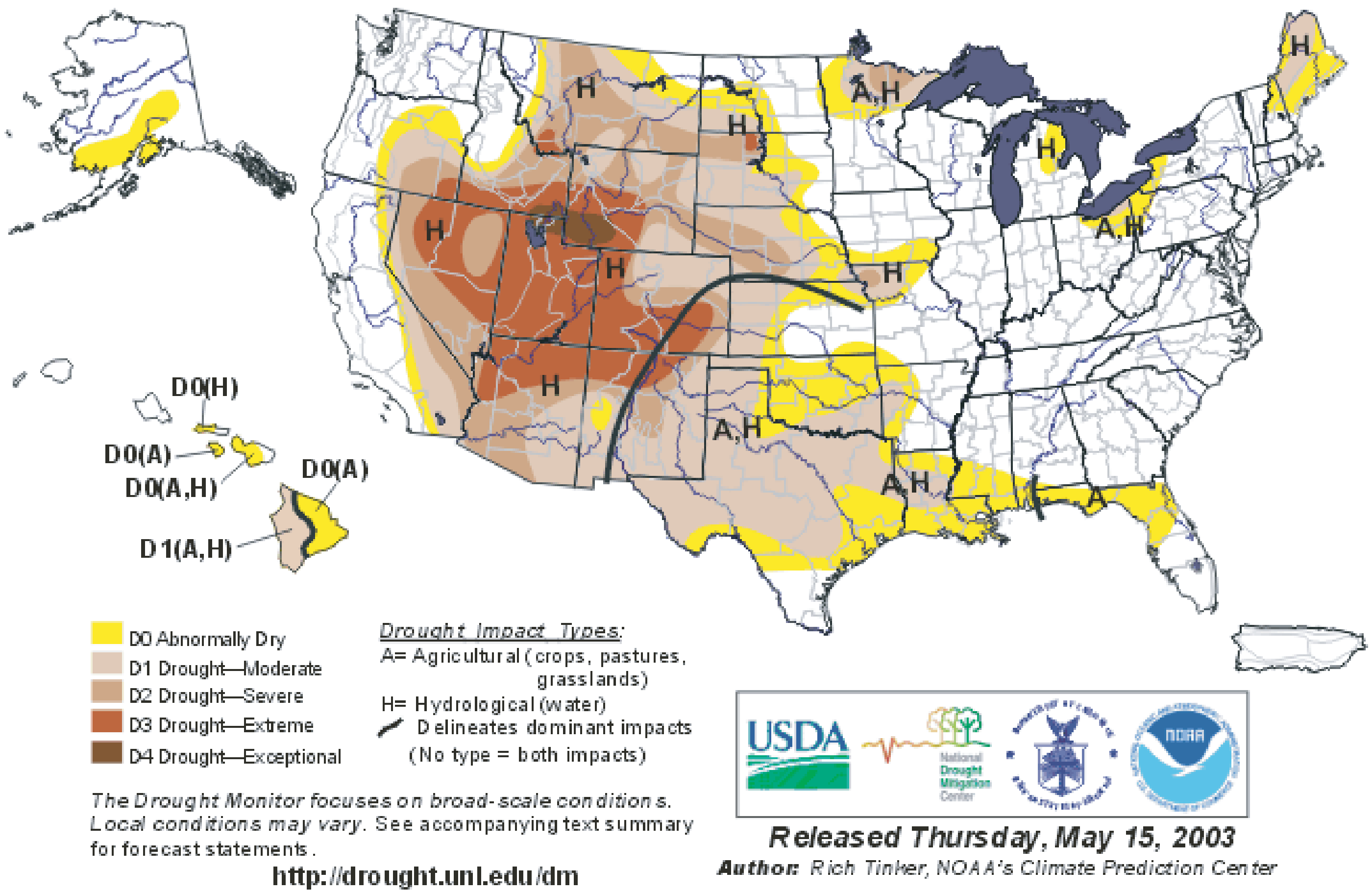
The data are in inches of precipitation. **Note: The scales for Figures 2b & 2d are non-linear.**

Departure from average precipitation is calculated by subtracting current data from the average and can be positive or negative.

These maps are derived by taking measurements at meteorological stations (at airports) and estimating a continuous map surface based on the values of the measurements and a mathematical algorithm. This process of estimation also is called spatial interpolation.

The red and blue numbers shown on the maps represent individual stations. The contour lines and black numbers show average precipitation.

3. U.S. Drought Monitor (updated 05/13/03) ♦ Source: USDA, NDMC, NOAA



Notes:

The U.S. Drought Monitor is released weekly (every Thursday) and represents data collected through the previous Tuesday. This monitor was released on 05/15 and is based on data collected through 05/13 (as indicated in the title).

The best way to monitor drought trends is to pay a weekly visit to the U.S. Drought Monitor website (see left and below).

The U.S. Drought Monitor maps are based on expert assessment of variables including (but not limited to) PDSI, soil moisture, stream flow, precipitation, and measures of vegetation stress, as well as reports of drought impacts.

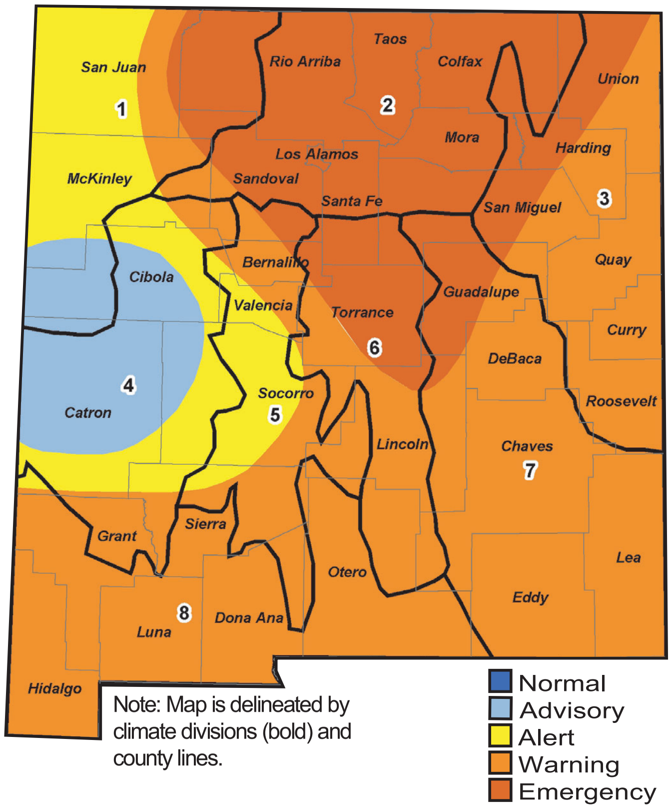
Highlights: Drought categories have increased across most of New Mexico (with the exception of the west-central mountains) and they have remained unchanged across Arizona. Of particular note are the following: an increase in the area of extreme drought across northern New Mexico and a return to moderate drought across eastern and southern New Mexico. As we continue through the dry pre-monsoon period in the Southwest, we can expect what little snow remains on the landscape to melt and evaporation to increase—the latter exacerbated by increase chances of above-average temperatures, especially across the western and southern parts of Arizona and New Mexico. Perhaps the most important drought concerns are related to long-term hydrological conditions (i.e., surface and groundwater supply) and medium-term agricultural conditions. Long-term soil moisture deficits from years of drought across our region and a lack of late spring precipitation have left dryland farming areas in New Mexico especially susceptible to wind damage and erosion. The most recent release of national range and pasture status from the USDA (May 11, 2003) indicates that New Mexico and Arizona have the poorest conditions in the United States.

Animations of the current and past weekly drought monitor maps can be viewed at: http://www.drought.unl.edu/dm/monitor.html

4. Drought: Recent Drought Status for New Mexico (updated 05/09/03) ♦ Source: New Mexico NRCS

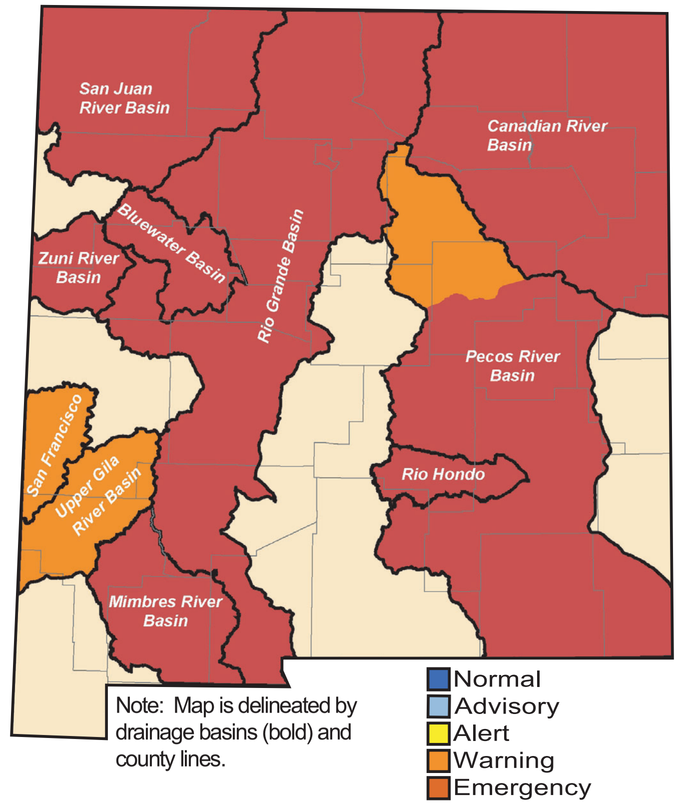
Meteorological Drought Map

Drought Status as of May 9, 2003



Hydrological Drought Map

Drought Status as of May 9, 2003



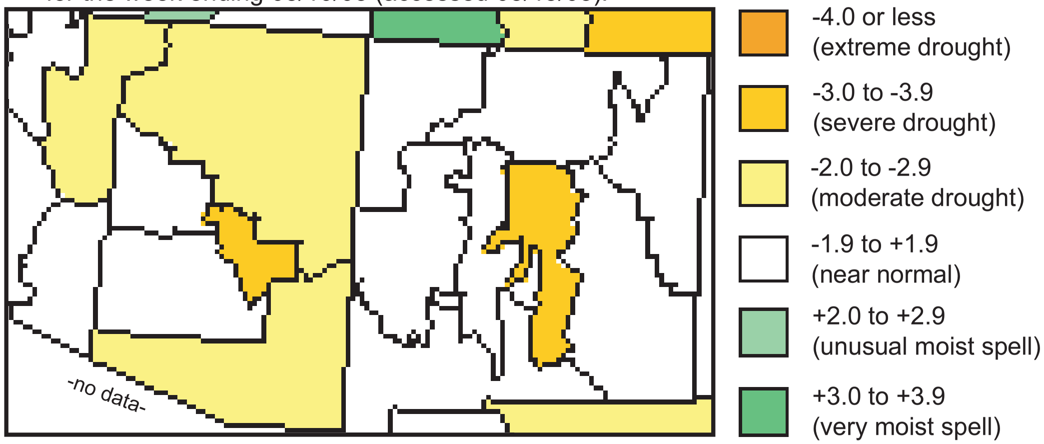
Notes: New Mexico drought status, updated by the New Mexico Natural Resource Conservation Service (NRCS) in conjunction with the New Mexico Drought Planning Team, now contains a short-term *meteorological* drought map (left) and a long-term *hydrological* drought map (right). The new drought maps reflect changes in the *trigger mechanisms* used to determine drought status in New Mexico. These include a greater emphasis on hydrological drought measures. During the next year, expect an Arizona drought status map from the recently created Arizona Drought Task Force.

Highlights: The entire state of New Mexico is in some form of short-term drought status; the north-central uplands of New Mexico are in emergency short-term status, consistent with depleted soil moisture, accelerated erosion, and poor rangeland conditions. The New Mexico Drought Monitor Committee has declared emergency status for many of the major river basins in New Mexico (e.g., Rio Grande, Pecos). Reservoir storage is well below normal and projections suggest reservoir storage in the Rio Grande and Pecos basins is likely to be even lower by late summer. Emergency status is consistent with likely increased water use regulation.

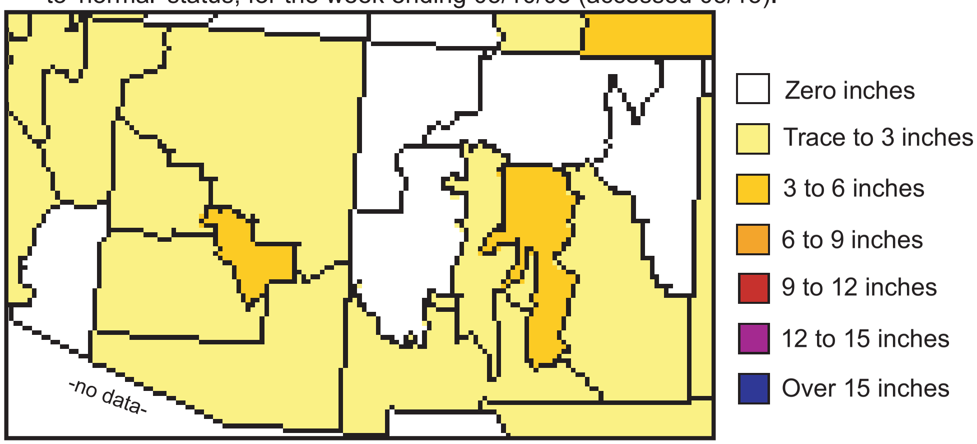
The New Mexico map (http://www.nm.nrcs.usda.gov/drought/drought.htm), currently is produced monthly, but when near-normal conditions exist, it is updated quarterly. Contact Matt Parks at Arizona Department of Emergency Management at (602) 392-7510 for more information on Arizona drought declarations.

5. PDSI Measures of Recent Conditions (up to 05/10/03) ♦ Source: NOAA Climate Prediction Center

5a. Current weekly Palmer Drought Severity Index (PDSI), for the week ending 05/10/03 (accessed 05/15/03).



5b. Precipitation needed to bring current weekly PDSI assessment to 'normal' status, for the week ending 05/10/03 (accessed 05/15).



Notes:
The PDSI (Palmer Drought Severity Index) attempts to measure the duration and intensity of long-term conditions that underlie drought.

'Normal' on the PDSI scale is defined as amounts of moisture that reflect long-term climate expectations.

Arizona and New Mexico are divided into *climate divisions*. Climate data are aggregated and averaged for each division within each state. Note that climate division calculations stop at state boundaries.

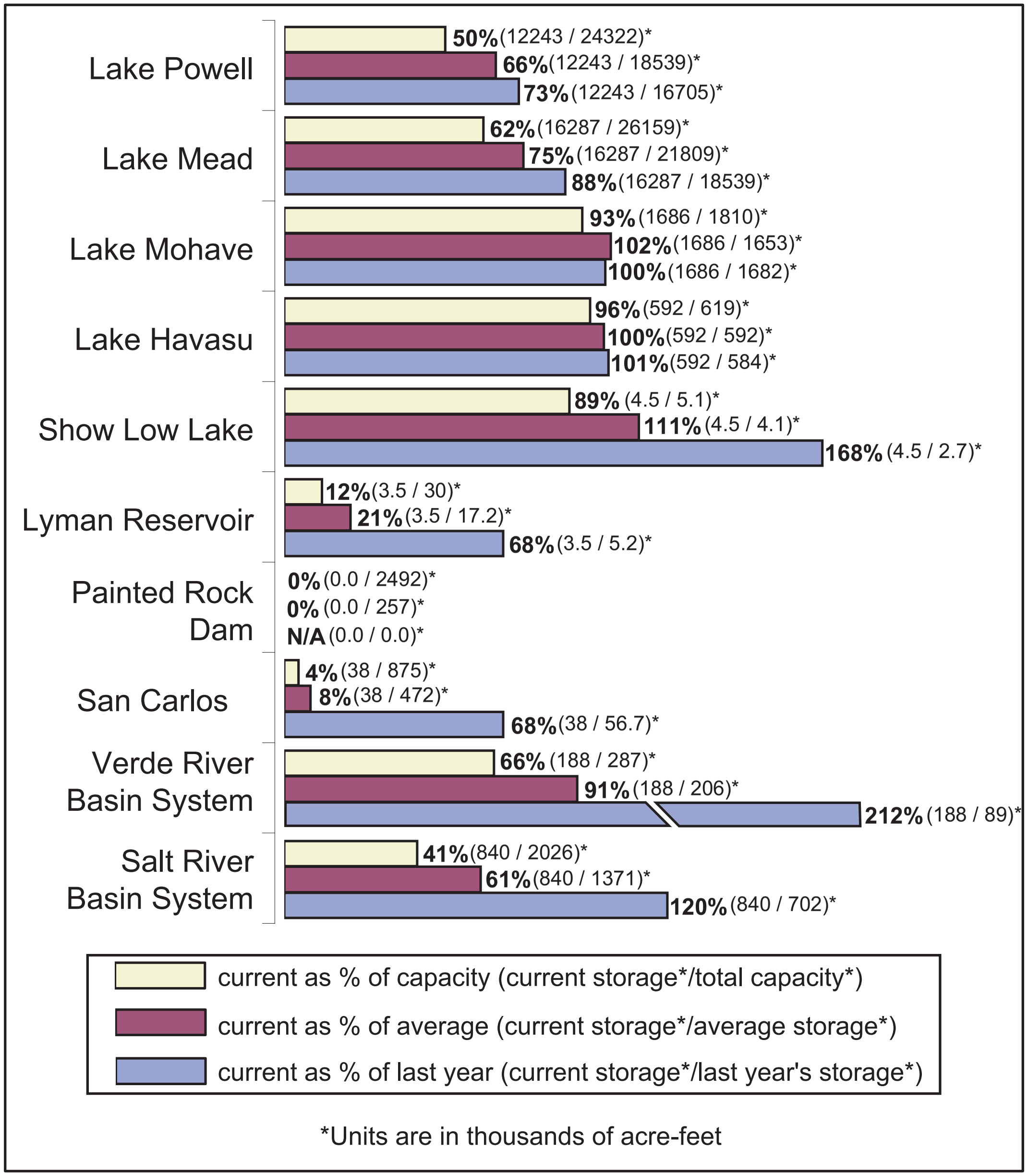
These maps are issued weekly by the NOAA CPC.

Highlights: Compared with one month ago, short-term drought conditions have increased in most of Arizona and New Mexico (Figure 5a). In particular, PDSI values in eastern Arizona and central New Mexico indicate increased short-term drought severity. The amount of precipitation necessary to ameliorate meteorological drought conditions has increased for central and southwestern New Mexico. Cool temperatures and late-April/early May precipitation across southwestern Utah also touched northwestern Arizona and helped improve short-term drought conditions there.

For a more technical description of PDSI, visit: http://www.cpc.noaa.gov/products/analysis_monitoring/cdus/palmer_drought/ppdanote.html

For information on drought termination and amelioration, visit: http://lwf.ncdc.noaa.gov/oa/climate/research/drought/background.html

6. Arizona Reservoir Levels (through the end of April 2003) ♦ Source: USDA NRCS



Notes: Reservoir reports are updated monthly and are provided by the National Water and Climate Center (NWCC) of the U.S. Department of Agriculture's Natural Resource Conservation Service (NRCS). 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

As of 05/14/03, Arizona's report had been updated through the end of April.

For additional information, contact Tom Pagano of the NWCC-NRCS-USDA (tpagano@wcc.nrcs.usda.gov; 503-414-3010) or Larry Martinez, NRCS, USDA, 3003 N. Central Ave, Suite 800, Phoenix, Arizona 85012-2945; 602-280-8841; Larry.Martinez@az.usda.gov)

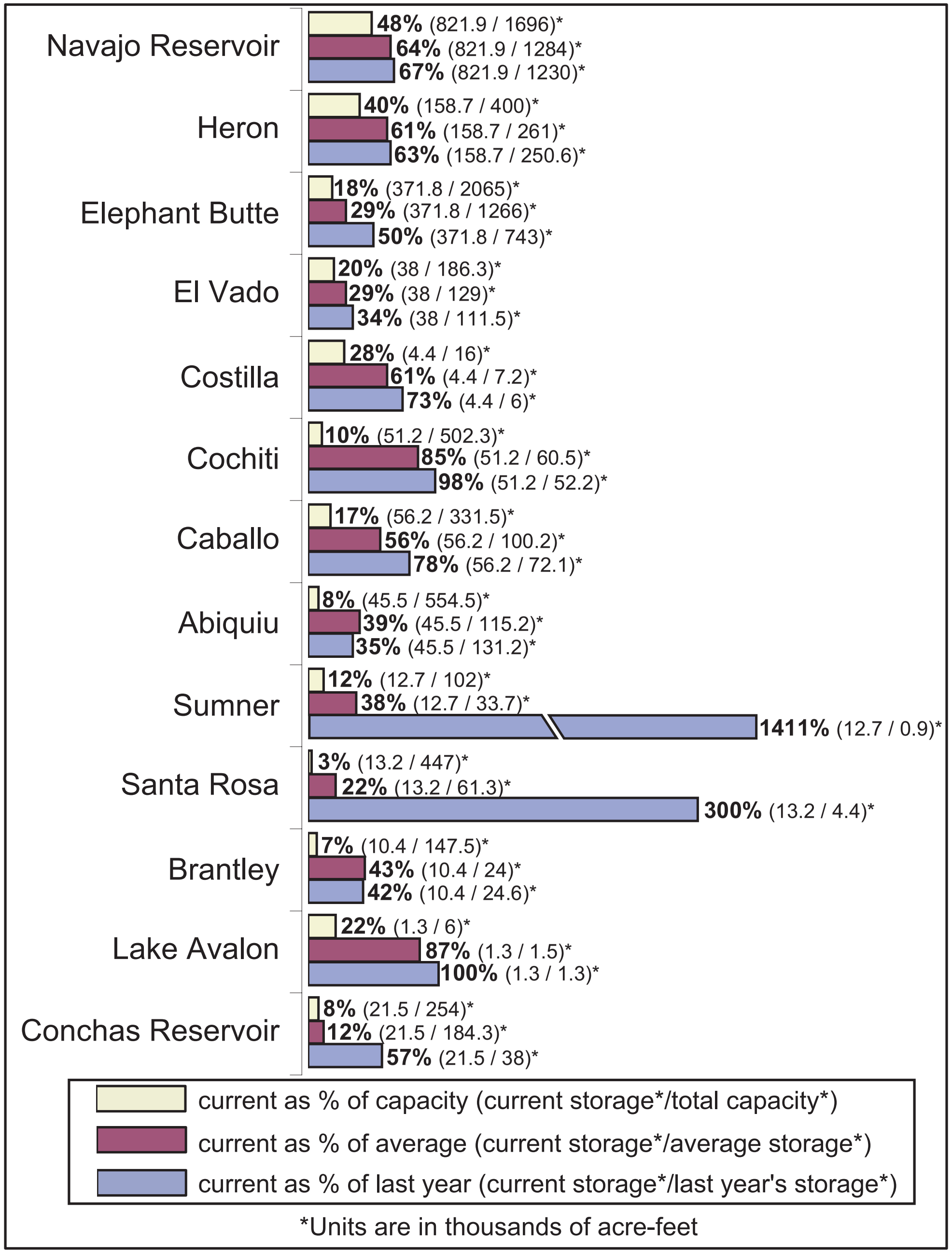
Highlights: Arizona reservoir levels have mostly held steady or decreased slightly since last month. Of particular note are decreases in the Verde River Basin System, San Carlos Reservoir, Lake Powell, and Lake Mead. Salt River Basin storage has increased.

Interior Secretary Gale Norton's *Water 2025* report for the nation highlighted Arizona areas of potential water emergency and conflict, including rural Arizona from Williams, Prescott and Flagstaff across the Mogollon Rim to Payson and Pine (*Arizona Republic* May l0, 2003).

In addition, low streamflow on the Upper Gila River, combined with decreasing San Carlos reservoir levels, means a high likelihood of limited or no surface water allotments for irrigators in southeastern Arizona's Gila River Valley.

Page, Arizona amended a water use ordinance, in order to anticipate a possible water emergency this summer. The ordinance restricts lawn watering and vehicle washing (*Arizona Daily Sun* April 26, 2003).

7. New Mexico Reservoir Levels (through the end of April 2003) Source: USDA NRCS



Notes: Reservoir reports are updated monthly and are provided by the National Water and Climate Center (NWCC) of the U.S. Department of Agriculture's Natural Resource Conservation Service (NRCS). Reports can be accessed at their website: (http://www.wcc.nrcs.usda.gov/wsf/reservoir/resv_rpt.html).

As of 05/14/03, New Mexico's report has been updated through the end of April.

For additional information, contact Tom Pagano of the NWCC-NRCS-USDA (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)

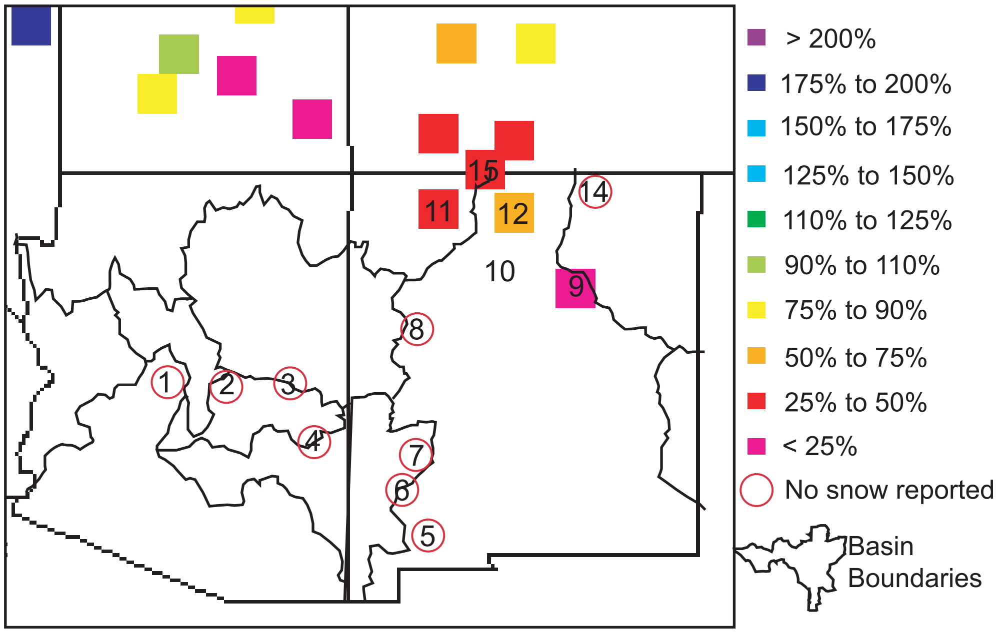
Highlights: Across New Mexico, reservoir levels have mostly held steady or increased slightly due to snowmelt runoff. Most New Mexico reservoir storage is below 2002 levels. Of particular note, Elephant Butte Reservoir storage continues to drop. All New Mexico reservoirs are still reporting levels ***far below the long-term average***.

The New Mexico Natural Resources Conservation Service reports that "the demand for water has out run the supply." They caution that future water management and water conservation measures will be critical in both wet and dry years in order to make the most of New Mexico water supply.

The *Santa Fe New Mexican* (May 16, 2003) reported the release of 3,000 acre-feet (approximately 326,000 gallons) of water from Abiquiú Reservoir to encourage the Rio Grande silvery minnow spawning. The minnow spawns in response to several conditions, including increases in river-water surges or pulses from melting snow according to the U.S. Bureau of Reclamation. The water was released because there was not enough spring runoff in the drought-stricken Rio Grande basin. The agency also released more water from the Navajo Reservoir to help endangered fish in the San Juan River.

8. Snowpack in the Southwestern United States (updated 05/15/03) ♦ Source: USDA NRCS, WRCC

8. Basin average snow water content (SWC) for available monitoring sites as of 05/15/03 (% of average).



Arizona Basins	New Mexico Basins	
1 Verde River Basin	5 Mimbres River Basin	11 San Miguel, Dolores, Animas, and San Juan River Basins
2 Central Mogollon Rim	6 San Francisco River Basin	12 Rio Chama River Basin
3 Little Colorado - Southern Headwaters	7 Gila River Basin	13 Cimarron River Basin
4 Salt River Basin	8 Zuni/Bluewater River Basin	14 Sangre de Cristo Mountain Range Basin
	9 Pecos River	15 San Juan River Headwaters
	10 Jemez River Basin	

Highlights: As of May 15, 2003, snowpack has melted from the majority of sites in Arizona and New Mexico. The remaining snow water content (SWC) measurements from northern New Mexico are well below the 1971-2000 average. During the end of April and first half of May, much of the above-average spring snowpack in northern New Mexico diminished due to dry, windy conditions. As significant precipitation is not likely until the arrival of summer monsoon rainfall in late June or early July, we have probably seen the end of this year's snow season. Across most of the region we can expect below-average snowmelt runoff. Moreover, as of May 19, 2003, river basin SWC for Utah, Colorado, and southwestern Wyoming is well below the long-term average—which will likely result in lower than average Colorado River streamflow.

For color maps of SNOTEL basin SWC, visit: http://www.wrcc.dri.edu/snotelanom/basinswe.html
For a numeric version of the SWC map, visit: http://www.wrcc.dri.edu/snotelanom/basinswen.html

Notes:

The data shown on this page are from snowpack telemetry (SNOTEL) stations grouped according to river basin. These remote stations sample snow, temperature, precipitation, and other parameters at individual sites.

Snow water content (SWC) and snow water equivalent (SWE) are different terms for the *same* parameter.

The SWC in Figure 8 refers to the snow water content found at selected SNOTEL sites in or near each basin compared to the *average* value for those sites on this day. *Average* refers to the arithmetic mean of annual data from 1971-2000. SWC is the amount of water currently in snow. It depends on the density and consistency of the snow. Wet, heavy snow will produce greater SWC than light, powdery snow.

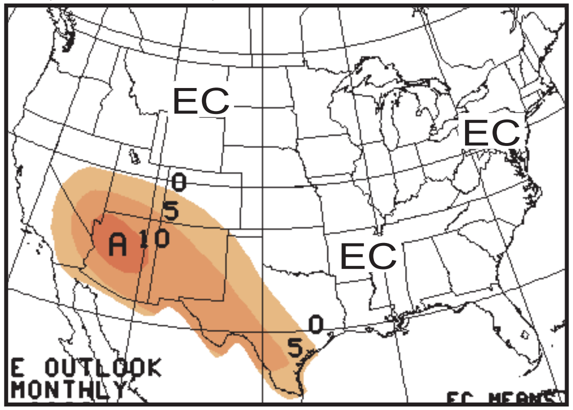
Each box on the map represents a river basin for which SWC data from individual SNOTEL sites have been averaged. Arizona and New Mexico river basins for which SNOTEL SWC estimates are available are numbered in Figure 8. The colors of the boxes correspond to the % of average SWC in the river basins. ***NOTE: stations not reporting SWC this month (but that did so previously) are circled in red.***

The dark lines within state boundaries delineate large river basins in the Southwest.

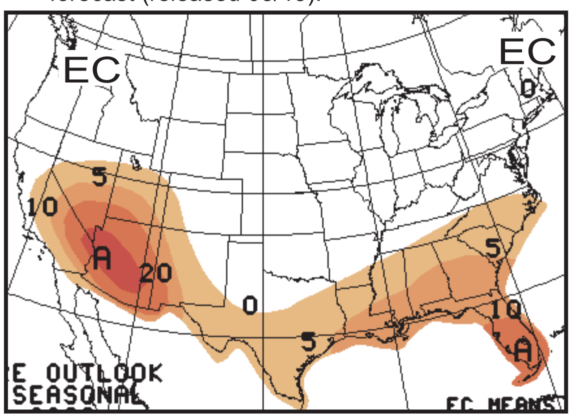
These data are provisional and subject to revision. They have not been processed for quality assurance. However, they provide the best available land-based estimates during the snow measurement season.

9. Temperature: Monthly and 3-Month Outlooks ♦ Source: NOAA Climate Prediction Center

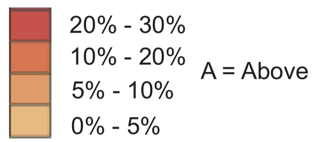
9a. June 2003 U.S. temperature forecast (released 05/15)



9b. June - August 2003 U.S. temperature forecast (released 05/15).



Percent Likelihood of Above and Below Average Temperatures*



*EC indicates no forecasted anomalies due to lack of model skill.

Notes:

The NOAA CPC (National Oceanic and Atmospheric Administration Climate Prediction Center) outlooks predict the “excess” 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.

In a situation where there is no forecast skill, one might look at *average* conditions in order to get an idea of what might happen. Using past climate as a guide to average conditions and dividing the past record into 3 categories, there is a 33.3% chance of above-average, a 33.3% chance of average, and a 33.3% chance of below-average temperature.

Thus, using the NOAA CPC excess likelihood forecast, in areas with light brown shading (0-5% excess likelihood of above average) there is a 33.3-38.3% chance of above-average, a 33.3% chance of average, and a 28.3-33.3% chance of below-average temperature.

The term *average* refers to the 1971-2000 average. This practice is standard in the field of climatology.

Equal Chances (EC) indicates areas where reliability (i.e., the ‘skill’) of the forecast is poor and no anomaly prediction is offered.

These forecasts are based on a combination of factors, including the results of statistical models, moderate El Niño conditions, and long-term trends.

Highlights: The NOAA-CPC temperature outlook for June (Figure 9a) indicates increased probabilities (33% to 53% likelihood) of above-average temperatures for the Southwest, with the highest forecast confidence centered on northern Arizona. The CPC June-August seasonal outlook (Figure 9b) shows even higher increases in the probability of above-average temperatures (33%-63% likelihood), especially across Arizona. The International Research Institute (IRI) for Climate Prediction also indicates an increase in the chances of above-average temperatures in the Southwest for June-August (*not pictured*), with a region of 50% likelihood of above-average temperatures centered over northern Mexico and southwestern Arizona. The CPC predictions are based chiefly on 28 cold ENSO (La Niña) tropical Pacific Ocean cases (see page 17) from the historical record, as well as long-term temperature trends. NOAA CPC climate outlooks are released on the Thursday, between the 15th and 21st of each month.

For more information, visit: http://www.cpc.ncep.noaa.gov/products/predictions/multi_season/13_seasonal_outlooks/color/churchill.html

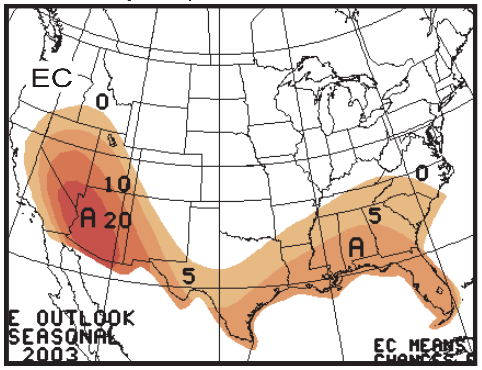
Please note that this website has many graphics and may load slowly on your computer.

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

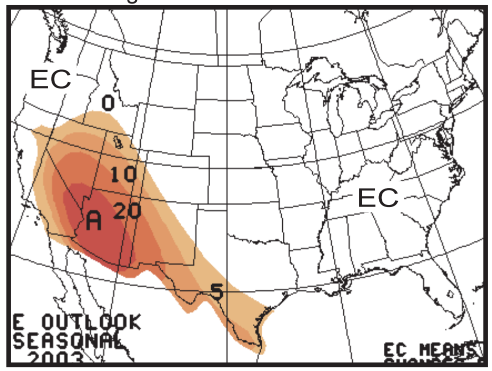
10. Temperature: Multi-season Outlooks ♦ Source: NOAA Climate Prediction Center

Overlapping 3-month long-lead temperature forecasts (released 05/15/03).

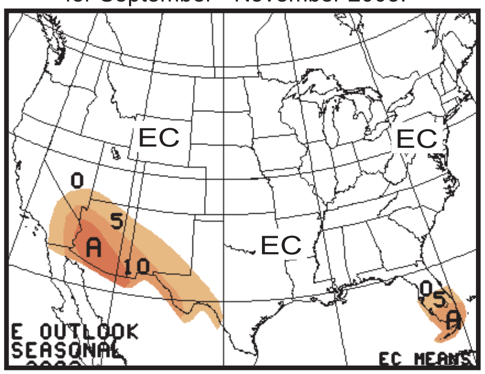
10a. Long-lead national temperature forecast for July - September 2003.



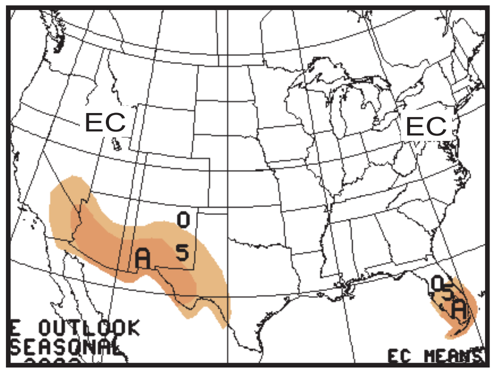
10b. Long-lead national temperature forecast for August - October 2003.



10c. Long-lead national temperature forecast for September - November 2003.



10d. Long-lead national temperature forecast for October - December 2003.



Percent Likelihood of Above and Below Average Temperatures*

- 30% - 40%
- 20% - 30%
- 10% - 20% A = Above
- 5% - 10%
- 0% - 5%

*EC indicates no forecasted anomalies due to lack of model skill.

Highlights: The NOAA-CPC temperature outlooks for July-November 2003 show increased probabilities of above-average temperatures for most of the Southwest (Figures 10a-d), with maximum forecast confidence centered over Arizona. There is a high probability of above-average temperatures across Arizona and western New Mexico during the forecast period, with the likelihood of above-average temperatures reaching 53 to 63% over western Arizona throughout the summer and early fall. These forecasts are based chiefly on 28 cold ENSO (La Niña) tropical Pacific Ocean cases (see page 17) from the historical record toward above-average temperatures, reinforced by long-term trends. IRI temperature forecasts (*not pictured*) also indicate an increased likelihood of the above-average temperatures across our region for the July-November forecast period. Less confident CPC forecasts are made for October-December, based chiefly on the persistence of a weak-to-moderate La Niña, reinforced by statistical models and long-term temperature trends.

For more information on CPC forecasts, visit:
http://www.cpc.ncep.noaa.gov/products/predictions/multi_season/13_seasonal_outlooks/color/churchill.html
Please 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/

Notes:
The NOAA CPC (National Oceanic and Atmospheric Administration Climate Prediction Center) outlooks predict the "excess" 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.

In a situation where there is no forecast skill, one might look at *average* conditions in order to get an idea of what might happen. Using past climate as a guide to average conditions and dividing the past record into 3 categories, there is a 33.3% chance of above-average, a 33.3% chance of average, and a 33.3% chance of below-average temperature.

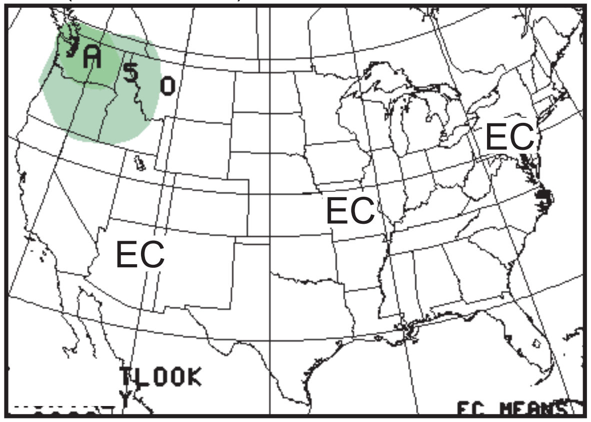
Thus, using the NOAA CPC excess likelihood forecast, in areas with light brown shading (0-5% excess likelihood of above average) there is a 33.3-38.3% chance of above-average, a 33.3% chance of average, and a 28.3-33.3% chance of below-average temperature.

The term *average* refers to the 1971-2000 average. This practice is standard in the field of climatology.

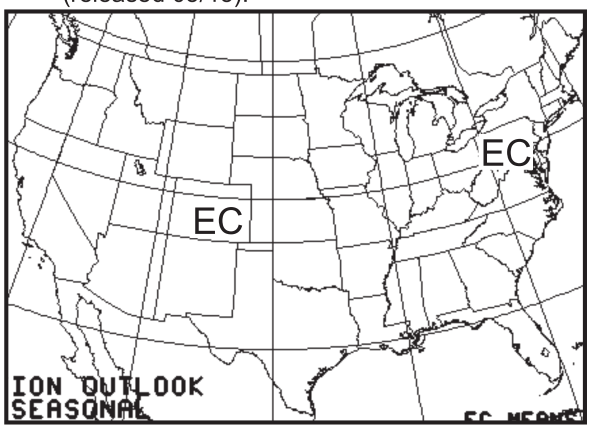
Equal Chances (EC) indicates areas where reliability (i.e., the 'skill') of the forecast is poor and no anomaly prediction is offered.

11. Precipitation: Monthly and 3-Month Outlooks ♦ Source: NOAA Climate Prediction Center

11a. June 2003 U.S. precipitation forecast (released 05/15).



11b. June - August 2003 U.S. precipitation forecast (released 05/15).



Percent Likelihood of Above Average Precipitation*

20% - 30%
10% - 20%
5% - 10%
0% - 5%

A = Above

*EC indicates no forecasted anomalies due to lack of model skill.

Notes:

The NOAA CPC (National Oceanic and Atmospheric Administration Climate Prediction Center) outlooks predict the "excess" 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.

In a situation where there is no forecast skill, one might look at *average* conditions in order to get an idea of what might happen. Using past climate as a guide to average conditions and dividing the past record into 3 categories, there is a 33.3% chance of above-average, a 33.3% chance of average, and a 33.3% chance of below-average precipitation.

Thus, using the NOAA CPC excess likelihood forecast, in areas with light green shading (0-5% excess likelihood of above average) there is a 33.3-38.3% chance of above-average, a 33.3% chance of average, and a 28.3-33.3% chance of below-average precipitation.

The term *average* refers to the 1971-2000 average. This practice is standard in the field of climatology.

Equal Chances (EC) indicates areas where reliability (i.e., the 'skill') of the forecast is poor and no anomaly prediction is offered.

These forecasts are based on a combination of factors, including the results of statistical models, moderate El Niño conditions, and long-term trends.

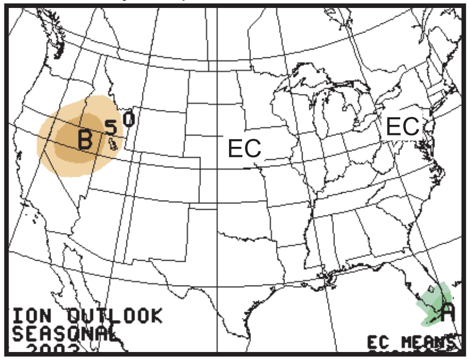
Highlights: The NOAA-CPC has reserved judgment in their precipitation outlooks for June (Figure 11a) and June-August (Figure 11b) in the Southwest. Their prognostic discussion says "Precipitation is considered to be unpredictable during June-August 2003…La Niña is often—though not always—associated with enhanced monsoon conditions over the southwestern United States. However – given [that] the odds of a La Niña are only about 60 percent—enhanced precipitation is not explicitly predicted in Arizona and New Mexico…" The June-August precipitation forecast from the International Research Institute (IRI) for Climate Prediction (*not pictured*) also withholds judgment.

For more information about NOAA-CPC seasonal outlooks, visit:
http://www.cpc.ncep.noaa.gov/products/predictions/multi_season/13_seasonal_outlooks/color/churchill.html
Please note that this website has many graphics and may load slowly on your computer.
For more information about IRI experimental seasonal forecasts, visit: http://iri.columbia.edu/climate/forecast/net_asmt/

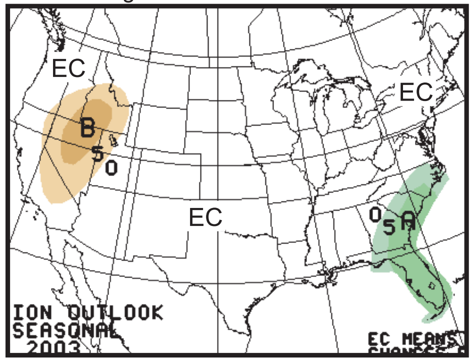
12. Precipitation: Multi-season Outlooks ♦ Source: NOAA Climate Prediction Center

Overlapping 3-month long-lead precipitation forcasts (released 05/15/03).

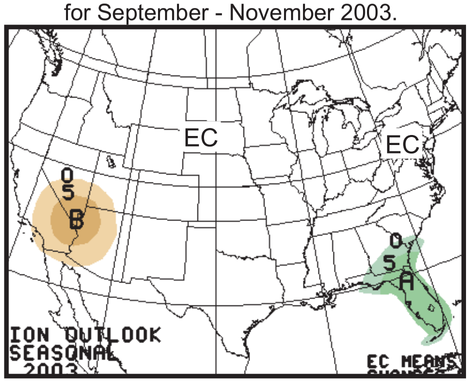
12a. Long-lead U.S. precipitation forecast for July - September 2003.



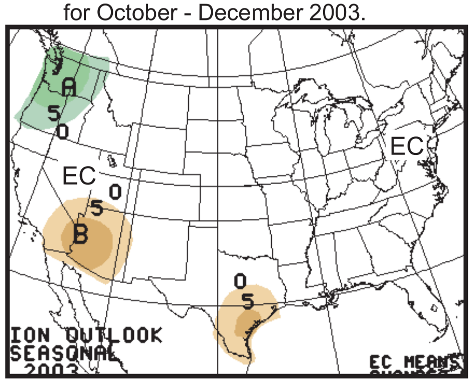
12b. Long-lead U.S. precipitation forecast for August - October 2003.



12c. Long-lead U.S. precipitation forecast for September - November 2003.



12d. Long-lead U.S. precipitation forecast for October - December 2003.



Percent Likelihood of Above or Below Average Precipitation*

Above: 5% - 10%; 0% - 5%

Below: 0% - 5%; 5% - 10%

*EC indicates no forecasted anomalies due to lack of model skill.

Highlights: NOAA-CPC forecasters have withheld judgment with regard to precipitation forecasts for the summer and early fall (Figures 12a-b) for the Southwest, which is a time period well-known for a lack of forecast skill. Figures 12c and 12d show small increases in the probability of below-average precipitation in some regions of the Southwest during the fall and early winter, based on a key forecast tool for the Southwest—trend-adjusted La Niña (see page 17) averages. The July-November precipitation forecast from the International Research Institute (IRI) for Climate Prediction (*not pictured*) withholds judgment.

NOAA CPC climate outlooks are released on Thursday, between the 15th and 21st of each month.
For more information, visit:
http://www.cpc.ncep.noaa.gov/products/predictions/multi_season/13_seasonal_outlooks/color/churchill.html
Please note that this website has many graphics and may load slowly on your computer.
For more information about IRI experimental forecasts, visit: http://iri.columbia.edu/climate/forecast/net_asmt/

Notes:

The NOAA CPC (National Oceanic and Atmospheric Administration Climate Prediction Center) outlooks predict the "excess" 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.

In a situation where there is no forecast skill, one might look at *average* conditions in order to get an idea of what might happen. Using past climate as a guide to average conditions and dividing the past record into 3 categories, there is a 33.3% chance of above-average, a 33.3% chance of average, and a 33.3% chance of below-average precipitation.

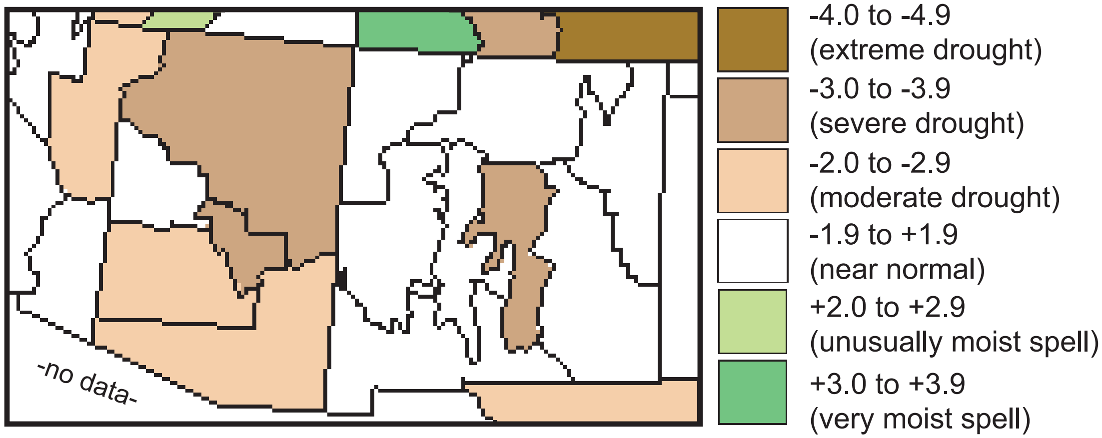
Thus, using the NOAA CPC excess likelihood forecast, in areas with light green shading (0-5% excess likelihood of above-average) there is a 33.3-38.3% chance of above-average, a 33.3% chance of average, and a 28.3-33.3% chance of below-average precipitation.

The term *average* refers to the 1971-2000 average. This practice is standard in the field of climatology.

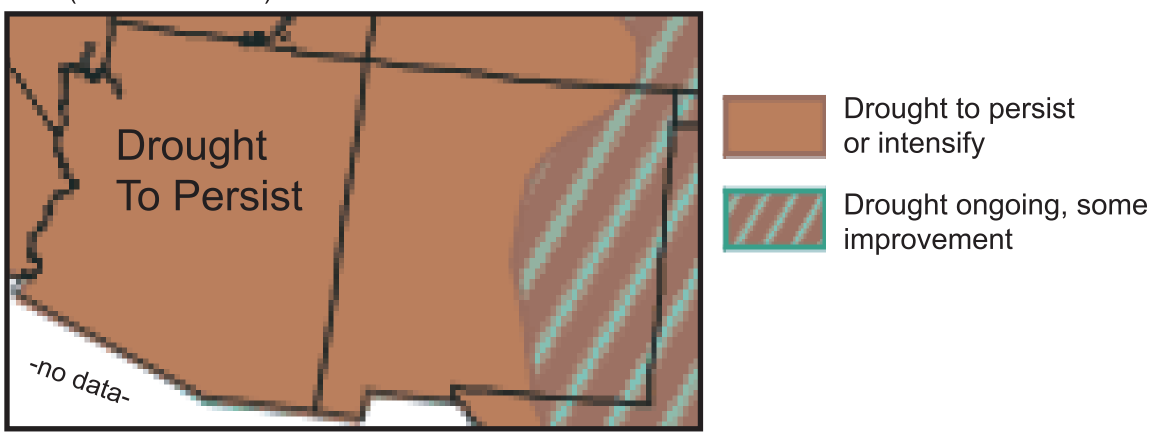
Equal Chances (EC) indicates areas where reliability (i.e., the 'skill') of the forecast is poor and no anomaly prediction is offered.

13. Drought: PDSI Forecast and U.S. Seasonal Outlook ♦ Source: NOAA Climate Prediction Center

13a. Short-term Palmer Drought Severity Index (PDSI) forecast through 05/17/03 (accessed 05/15).



13b. Seasonal drought outlook through August 2003 (accessed 05/15).



Notes:
The PDSI (Palmer Drought Severity Index) attempts to measure the duration and intensity of the climatological drought.

'Normal' on the PDSI scale is defined as amounts of moisture that reflect long-term climate expectations.

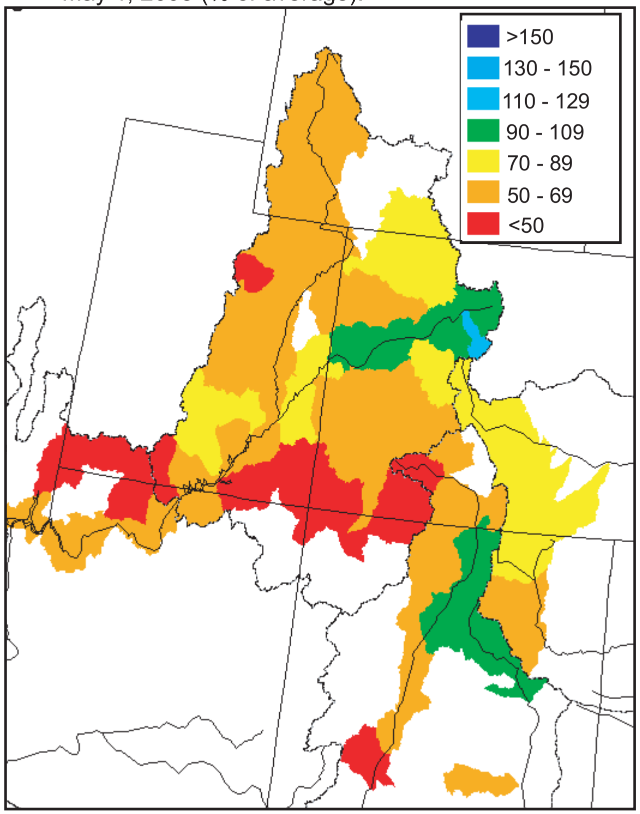
The delineated areas in the Seasonal Drought Outlook are defined subjectively and are based on expert assessment of numerous indicators including outputs of short- and long-term forecast models.

Highlights: The short-term Palmer Drought Severity Index (PDSI) forecast (Figure 13a) shows near-normal conditions across most of New Mexico. PDSI is expected to decrease (i.e., drought conditions will increase) across most of Arizona, with severe drought expected for northeastern Arizona and the Mogollon Rim. The NOAA-Climate Prediction Center suggests drought will persist throughout Arizona and western New Mexico (Figure 13b). Improvements to water supplies in most of the Southwest will be limited due to rapidly diminishing snowpack levels and forecasted increases in temperature. Moreover, conditions in the Southwest are typically dry during June and early July. Even if monsoon rains are heavier than normal, they are unlikely to make a significant reduction in the long-term moisture deficits across Arizona and much of New Mexico.

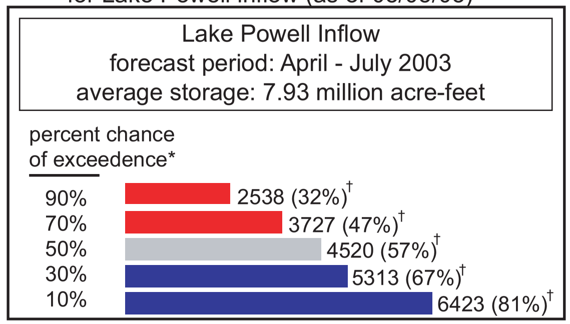
For more information, visit: http://www.drought.noaa.gov/

14. Streamflow Forecast for Spring and Summer ♦ Source: USDA NRCS National Water and Climate Center

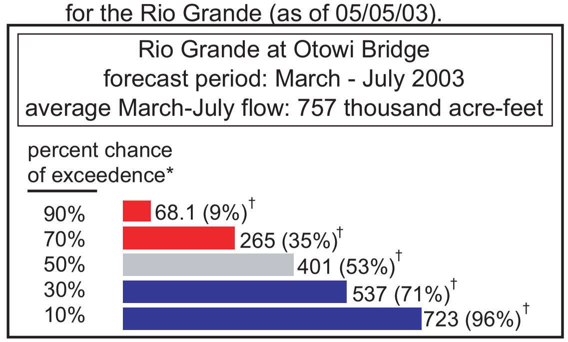
14a. NRCS spring and summer streamflow forecast as of May 1, 2003 (% of average).



14b. NRCS percent exceedence forecast chart for Lake Powell inflow (as of 05/05/03)



14c. NRCS percent exceedence forecast chart for the Rio Grande (as of 05/05/03).



*Likelihood of exceeding the forecast storage or flow.

†Forecast volume/flow (thousands of acre-feet) and percent of average volume/flow.

Highlights: April 1, 2003 is the last date for streamflow forecasts for most of Arizona. However, as of May 1, 2003, the most probable (50% exceedence) forecast for the Colorado River at Lake Powell is 57% of average, and the Virgin River at Littlefield forecast is 23% of average. As of May 1, 2003 below-average streamflow is forecasted for all New Mexico river basins. Moreover, total New Mexico reservoir storage is less than 50% of the long-term average, and projections suggest that reservoir systems storage in the Rio Grande and Pecos basins is likely to be even lower by late summer (National Weather Service, Albuquerque). Of particular note are ~50% of average most probable flows forecasted for the Rio Grande, Chama, Jemez, and San Juan river basins.

For state river basin streamflow probability charts, visit: http://www.wcc.nrcs.usda.gov/cgibin/strm_cht.pl
For information on interpreting streamflow forecasts, visit: http://www.wcc.nrcs.usda.gov/factpub/intrpret.html
For western U.S. water supply outlooks, visit http://www.wcc.nrcs.usda.gov/wsf/westwide.html

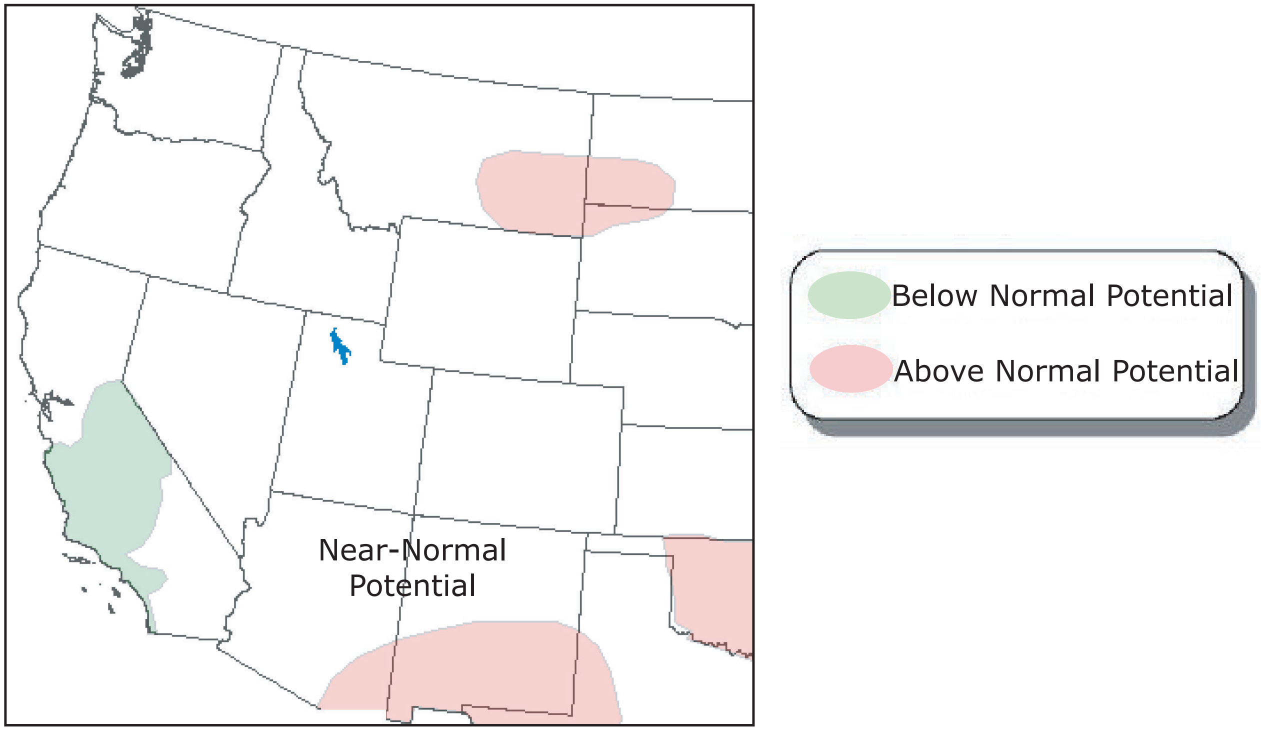
Notes:
The forecast information provided in Figures 14a-c is updated monthly and is provided by the National Resources Conservation Service (NRCS). Unless otherwise specified, all streamflow forecasts are for streamflow volumes that would occur naturally without any upstream influences, such as reservoirs and diversions.

Each month, five streamflow volume forecasts are made by the NRCS for several river basins in the United States. These five forecasts correspond to standard *exceedence* percentages, which can be used as approximations for varying 'risk' thresholds when planning for short-term future water availability.

90%, 70%, 50%, 30%, and 10% exceedence percentage streamflow volumes are provided by the NRCS. Each exceedence percentage level corresponds to the following statement: "There is an (X) percent chance that the streamflow volume will ***exceed*** the forecast volume value for that exceedence percentage." Conversely, the forecast also implies that there is a (100-X) percent chance the volume will be ***less than*** this forecasted volume. In Figure 14c, for example, there is a 30% chance that at Otowi Bridge the average streamflow during the forecast period (March through July) will exceed 537 acre-feet of water (71% of average), and a 70% chance that it will not. Note that for an individual location, as the exceedance percentage declines, forecasted streamflow volume increases.

In addition to monthly graphical forecasts for individual points along rivers (Figures 14b and 14c), the NRCS provides a forecast map (Figure 14a) of basin-wide streamflow volume averages based on the forecasted 50% exceedence percentage threshold.

15. National Wildland Fire Outlook (valid May 1–31, 2003) ♦ Source: National Interagency Fire Center

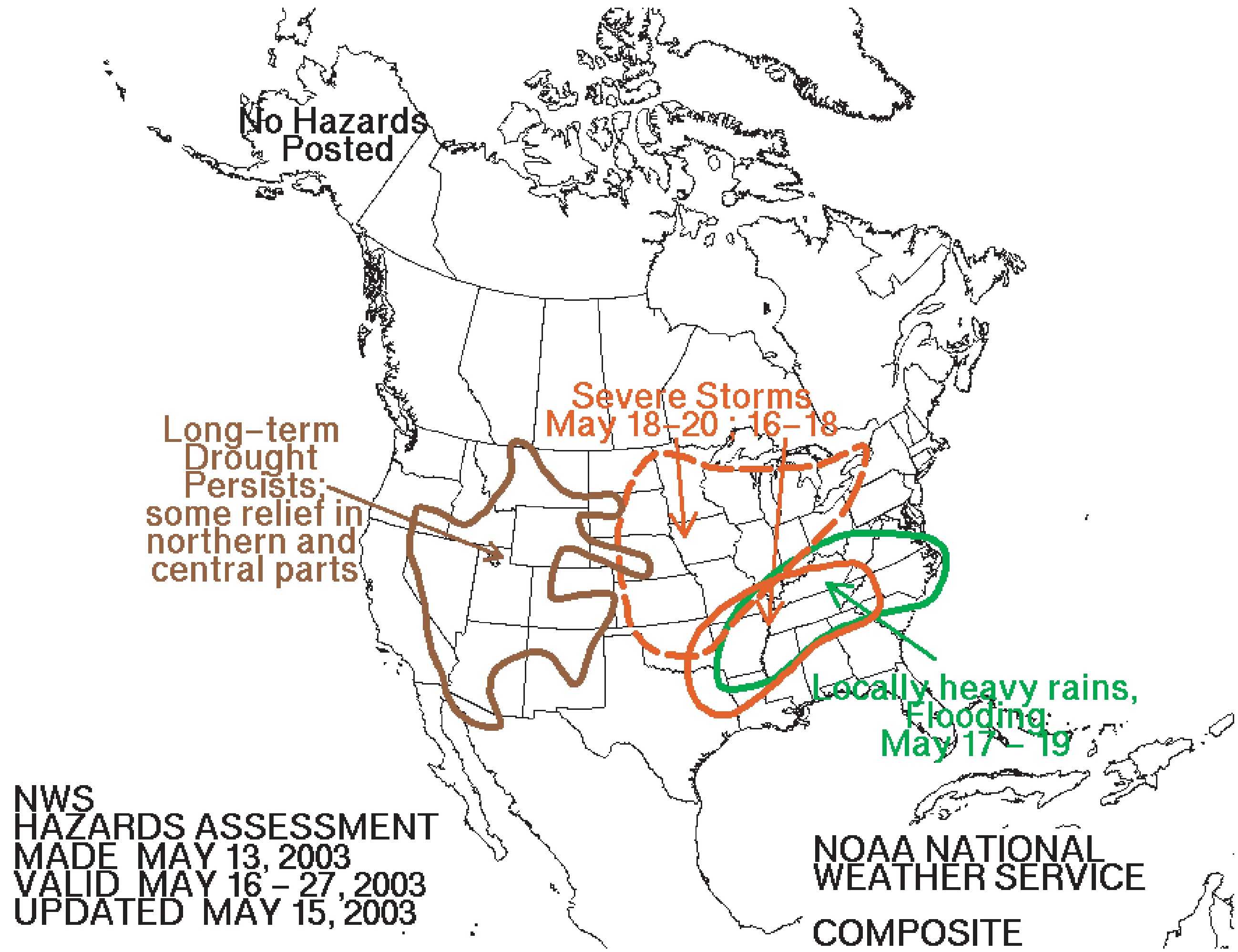


Notes: The National Interagency Coordination Center (NICC) at the National Interagency Fire Center (NIFC) produces monthly wildland fire outlooks (Figure 15). These forecasts consider climate forecasts and surface-fuels conditions to assess fire potential. They are subjective assessments, based on synthesis of regional fire danger outlooks.

Highlights: The Southwest fire season began much later than last year, as predicted. As of May 17, 2003, 15,859 acres have burned in Arizona and New Mexico, including several large (>100 acres) fires. The Wildland Fire Outlook for May 2003 indicates continued above-normal fire potential for southeastern Arizona, southern New Mexico, and southwest Texas. In their May 2003 report, forecasters at the Southwest Coordination Center (SWCC; a regional multiagency federal-state operation for coordinating fire-related information, resources, and firefighting mobilization) caution that general fire danger levels are near-to-above normal across much of the region, nearing historically critical levels across portions of southern New Mexico. Above normal large fire potential and firefighting resource use is expected mainly in elevations below 8500 feet (e.g., shrub-oak, pinyon-juniper, and pine woodlands). The worst-case scenario, prompted by little or no rainfall and dry conditions (i.e., conditions in most of our region since mid-April; see page 2) is for a majority of Arizona and New Mexico to transition rapidly to historically critical fire danger conditions in a short period of time. The recent update of the SWCC long-range fire assessment (April 30, 2003) cautions that soil moisture deficits, low live fuel moistures, along with large-scale tree mortality, and forecasted above-average temperatures "keep fire potentials poised for rapid acceleration to very high and extreme levels." At present, our region is in Fire Preparedness Level III—indicating a potential for two or more of our fire zones to experience incidents requiring a major commitment of firefighting resources.

For more detailed discussions, visit the National Wildland Fire Outlook web page: http://www.nifc.gov/news/nicc.html
and the Southwest Area Wildland Fire Operations web page: http://www.fs.fed.us/r3/fire/ (click on Predictive Services > Outlooks)

16. U.S. Hazards Assessment Forecast (valid May 16 – 27, 2003) Source: NOAA CPC



Notes:

The hazards assessment incorporates outputs of National Weather Service medium- (3-5 day), extended- (6-10 day) and long-range (monthly and seasonal) forecasts and hydrological analyses and forecasts.

Influences such as complex topography may warrant modified local interpretations of hazards assessments.

Please consult local National Weather Service offices for short-range forecasts and region-specific information.

Individual maps of each type of hazard are available at the following websites:

Temperature and wind:
http://www.cpc.ncep.noaa.gov/products/predictions/threats/t_threats.gif

Precipitation:
http://www.cpc.ncep.noaa.gov/products/predictions/threats/p_threats.gif

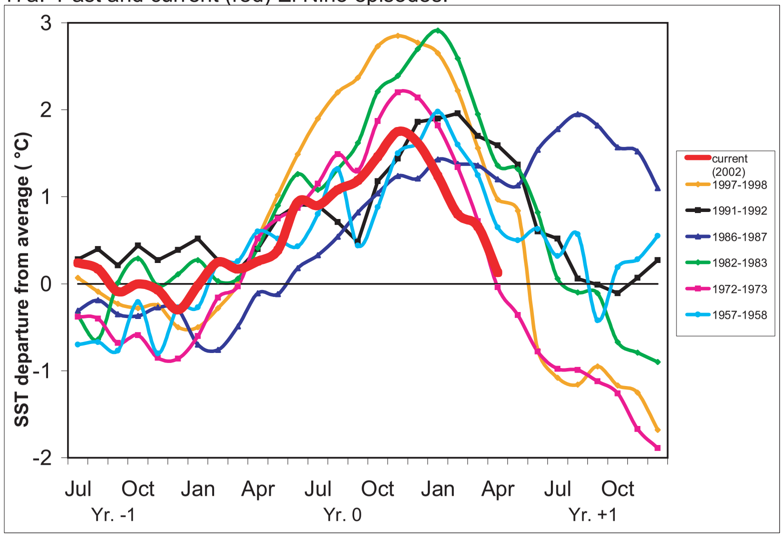
Soil and/or Fire:
http://www.cpc.ncep.noaa.gov/products/predictions/threats/s_threats.gif

Highlights: The U.S. Hazards Assessment indicates long-term, persistent drought for much of Arizona and northern New Mexico.

For more information, visit: http://www.cpc.ncep.noaa.gov/products/predictions/threats

17. Tropical Pacific SST and El Niño Forecasts ♦ Sources: NOAA CPC, IRI

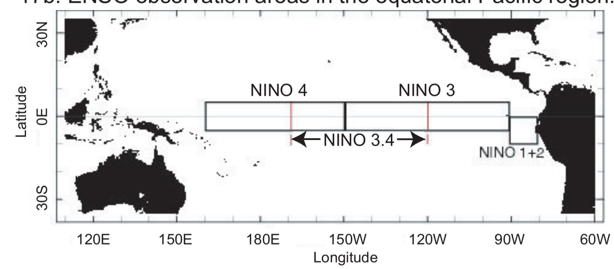
17a. Past and current (red) El Niño episodes.



Notes: The graph (Figure 17a) shows sea-surface temperature (SST) departures from the long-term average for the Niño 3.4 region (Figure 17b). This is a sensitive indicator of ENSO conditions.

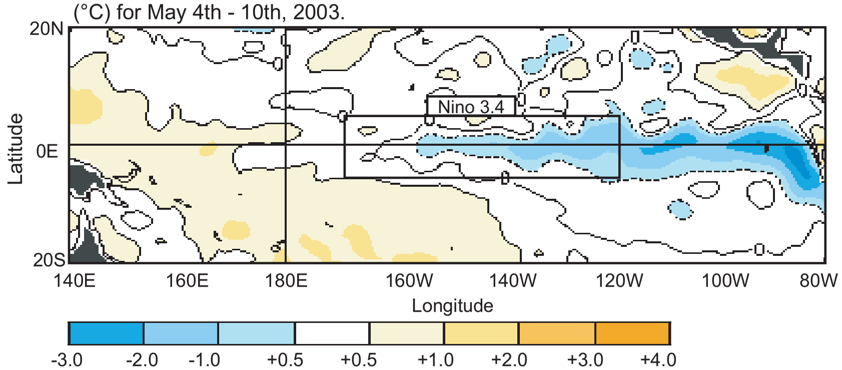
Each line on the graph represents SST departures for previous El Niño events, beginning with the year before the event began (Yr. –1), continuing through the event year (Yr. 0), and into the decay of the event during the subsequent year (Yr. +1).

17b. ENSO observation areas in the equatorial Pacific region.

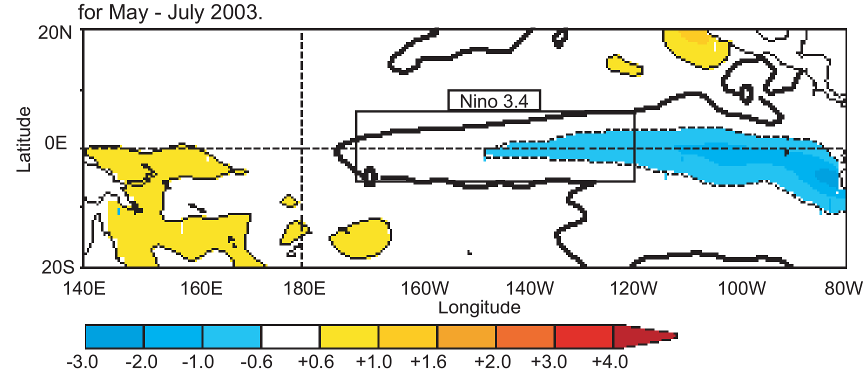


This year's SST departures are plotted as a red line (Figure 17a). The magnitude of the SST departure, its timing during the seasonal cycle, and its exact location in the equatorial Pacific Ocean are some of the factors that determine the degree of impacts experienced in the Southwest.

17c. 7-day averaged South Pacific sea surface temperature anomalies (°C) for May 4th - 10th, 2003.



17d. Forecasted South Pacific sea surface temperature anomalies (°C) for May - July 2003.



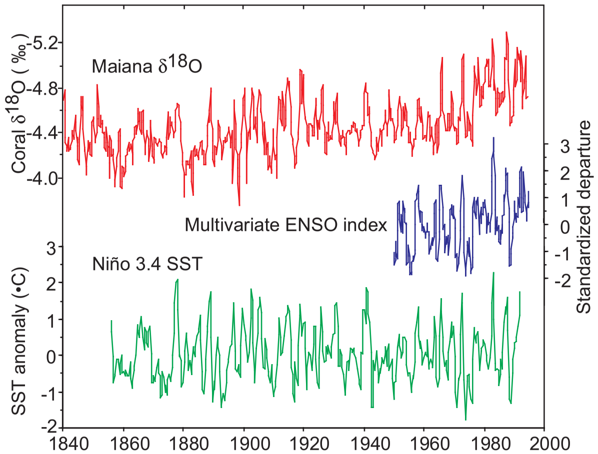
Highlights: During the last two months, equatorial Pacific Ocean sea-surface (SST) and subsurface temperatures have decreased rapidly and considerably (Figure 17a), especially in the eastern Pacific Ocean (Figure 17c). The International Research Institute for Climate Prediction (IRI) reports that "there is now a significant possibility that a La Niña may develop." Based on these observations and SST forecasts (e.g., Figure 17d), the likelihood is 55% that a La Niña will develop by June, with associated atmospheric effects by June or July. The IRI forecast cautions that at present it is difficult to predict the strength of a La Niña if one occurs, but that as the conditions evolve, some idea of the strength should be possible in the next two months. The IRI also notes that "the skill of SST forecast models is still relatively low at this time of year." NOAA-CPC concurs with the assessment that oceanic and atmospheric conditions show that a transition to La Niña is already underway. Based on historical climate records, La Niña brings warm temperatures, reliably dry winters, and *sometimes* early monsoons with greater summer precipitation to the Southwest.

For a technical discussion of current El Niño conditions, visit: http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/enso_advisory/

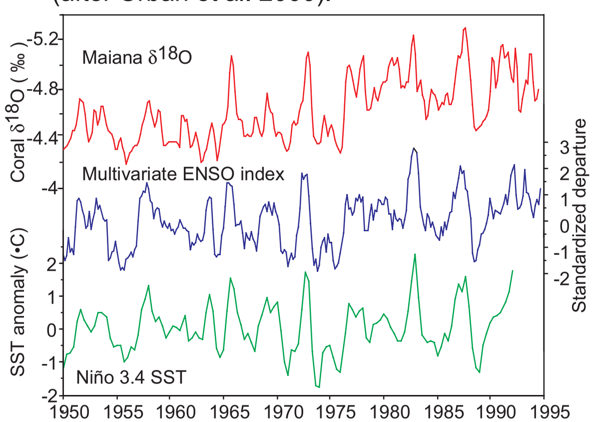
For more information about El Niño and to access the graphics found on this page, visit: http://iri.columbia.edu/climate/ENSO/

18. Paleoclimate Record of ENSO ♦ Source: Urban et al. 2000 and Cole et al. 2002

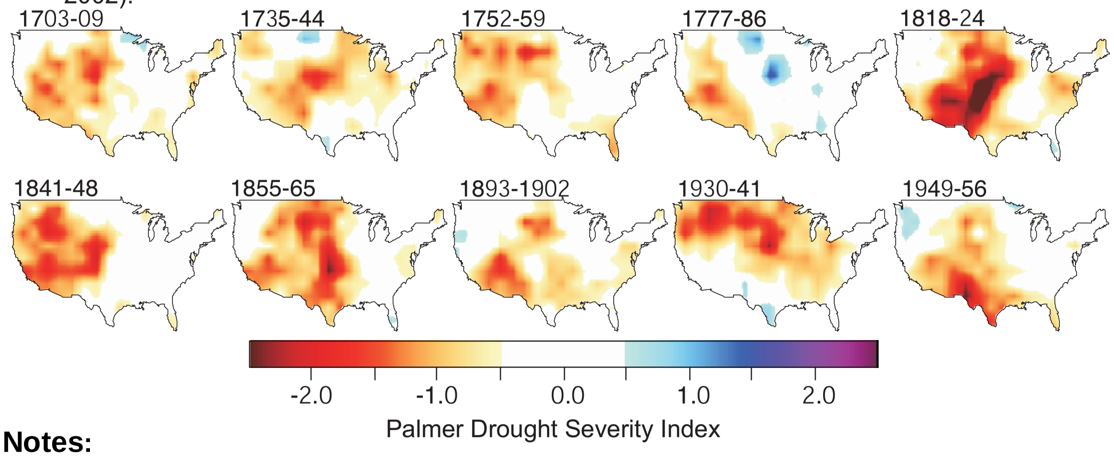
18a. Bimonthly records of tropical Pacific variability from coral and instrumental data, 1840-1995 (after Urban et al. 2000).



18b. Bimonthly records of tropical Pacific variability from coral and instrumental data, 1950-1995 (after Urban et al. 2000).



18c. Multiyear droughts, 1700-1978, and reconstructed Palmer Drought Severity Index (from Cole et al. 2002).



Notes:

Figures 18a-b show several records of variability in the tropical Pacific Ocean. The Multivariate ENSO Index and the Niño 3.4 SST index are both based on instrumental records and document the strength of the El Niño-Southern Oscillation (ENSO). The Maiana $\delta^{18}O$ shows the variation in oxygen isotope levels in the annual growth rings of coral from the Maiana Atoll in the equatorial Pacific Ocean. Oxygen isotope levels vary due to changes in the temperature and/or salinity of the water in which the coral grows. ENSO affects water temperature and salinity (through changes in precipitation) in the tropical Pacific Ocean and, therefore, in coral growth patterns. Smaller, more negative $\delta^{18}O$ values correspond to warmer, wetter (El Niño) conditions, and larger, less negative values correspond to cooler, drier (La Niña) conditions.

Figure 18c documents the severity of multiyear droughts in the United States since 1700, based on the Palmer Drought Severity Index (PDSI). This is related to tropical Pacific Ocean variability using the Maiana $\delta^{18}O$ ENSO reconstruction from Figures 18a-b and an index of the Pacific Decadal Oscillation (PDO).

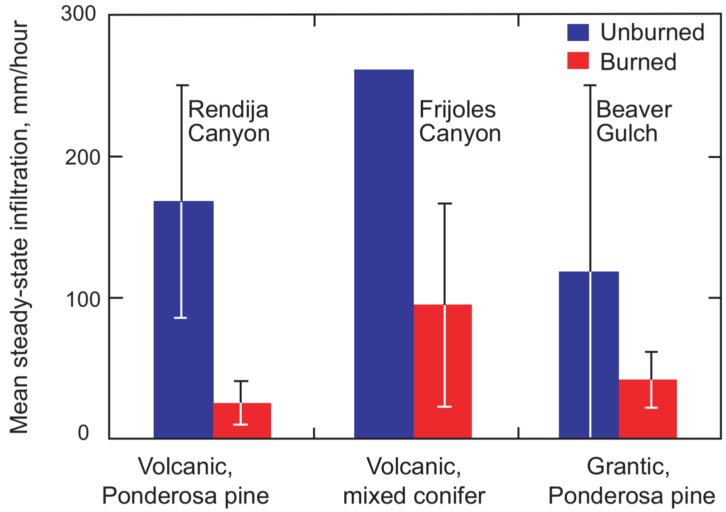
Highlights: University of Arizona researchers are at the forefront of research into the paleoclimate record of ENSO. Instrumental records of ENSO extend back in time only as far as the mid-1800s; however, proxy records, such as those derived from coral growth bands (Figures 18a-b) and tree rings, compare favorably to the instrumental record of ENSO and can be used to extend our knowledge of ENSO and its impacts on North American climate variability back in time (Figure 18c). Some of the most severe droughts in the United States since 1700 have coincided with prolonged La Niña conditions in the tropical Pacific and/or with negative PDO conditions. This implicates variability in the Pacific Ocean as a major cause of large-scale U.S. drought. For example, the 1703-1709 and the 1818-1824 droughts exactly coincided with La Niña events and the 1855-1865 drought coincided with negative PDO and La Niña conditions. Additionally, drought duration often extends past the end of La Niña conditions, indicating that additional feedbacks may promote multiyear droughts. The 1930-1941 Dustbowl drought is an interesting and unexplained exception—drought was confined to the northern United States and neither ENSO nor PDO conditions were extreme during this period.

For more information, visit http://www.ngdc.noaa.gov/paleo/paleo.html

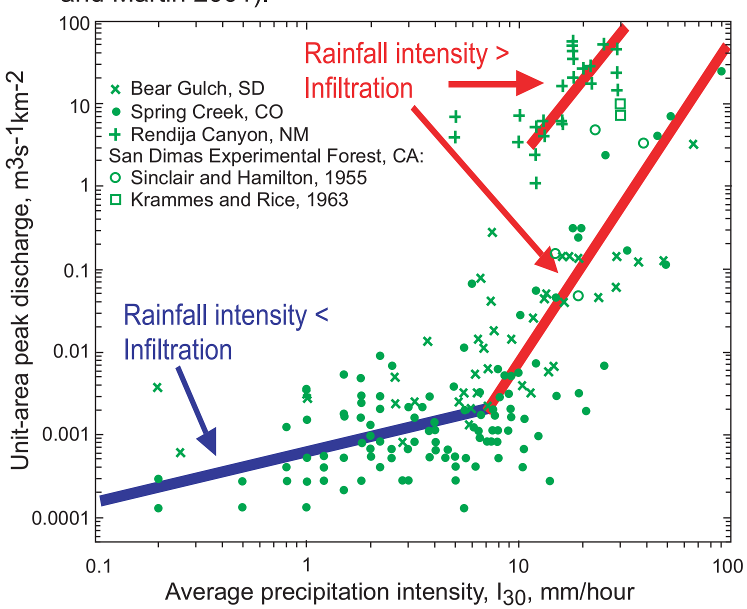
Cole, J., et al. 2002. Multiyear La Niña events and persistent drought in the contiguous United States. *Geophysical Research Letters* 29(13), DOI:10.1029/2001GLO13561, 25-1-25-4; Urban, F.E., et al. 2000. Influence of mean climate change on climate variability from a 155-year tropical Pacific coral record. *Nature* 407:989-993.

19. Flooding After Fire ♦ Source: Martin and Moody 2001; Moody and Martin 2001

19a. Infiltration rates for burned and unburned stands of pine and conifer trees on either granitic or volcanic soil (After Martin and Moody 2001).



19b. Rainfall-runoff relation for burned watersheds (After Moody and Martin 2001).



Notes:

Figure 19a illustrates the reduction in how much precipitation is absorbed (or infiltrates) into the soil for burned and unburned stands of pine and conifer trees in mountainous regions of the West. Rendija and Frijoles Canyons burned during the 2000 Cerro Grande fire in the Los Alamos, New Mexico area, and Beaver Gulch burned during the 2000 Hi Meadow fire in Colorado. Overall, infiltration rates are reduced for burned areas. Factors that affect infiltration include soil grain size and burn severity. Finer grain sizes experience greater reductions in infiltration due to fire-induced water repellency and sealing of pore spaces by ash. The Rendija Canyon results are an example of the combined effects of a high severity burn, due in part to high fuel loads, and volcanic soils. Volcanic soils, which are finer grained than granitic soils, experience greater reductions in infiltration as a result of wildfires.

Figure 19b shows the relationship between warm-season rainfall and runoff for burned watersheds. Unit-area peak discharge is the peak water volume flow divided by the burned drainage area. Maximum rainfall over thirty minutes (I_{30}) is a measurement of the intensity of a precipitation event, which then can be related to peak discharge. Runoff-rainfall relationships for three burned watersheds show a critical threshold intensity of about 10 mm per hour of rainfall, with lower discharges for rainfall events below the threshold (blue line) and much higher discharges for rainfall events above the threshold (red line).

Figures 19a-b and much of the information on this page are provided courtesy of D.A. Martin and J.A. Moody of the U.S. Geological Survey and are based on their research.

Highlights:

Wildfires alter the characteristics of watersheds in such a way that after a burn, the watershed may experience dramatic discharge and flooding in response to precipitation. Figure 19a is an example of the type of research that provides useful data for empirically based hillslope runoff and erosion models that can be used to predict the increase in runoff and erosion that result from mountainous wildfires.

Peak discharge relates directly to flood damage, so post-fire changes in peak discharge with respect to rainfall (Figure 19b) are an important component of modeling the magnitude of floods after wildfires in mountainous regions. Because wildfires reduce soil infiltration (Figure 19a), post-fire rainfall intensities that cause runoff and flooding may be lower than the pre-fire intensities required to produce comparable runoff. High-intensity precipitation events (above the 10 mm per hour critical threshold) may exceed the ability of the watershed's soils to absorb water. In this case, the runoff may produce flash floods.

Martin, D.A., and J.A. Moody. 2001. Comparison of soil infiltration rates in burned and unburned mountainous watersheds. *Hydrological Processes* 15:2893-2903, and Moody, J.A., and D.A. Martin. 2001. Post-fire, rainfall intensity-peak discharge relations for three mountainous watersheds in the western USA. *Hydrological Processes* 15:2981-2993.