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June 25, 2003

Dear ,

This packet marks the end of the END InSight Initiative, at least in its present form. The yearlong commitment we made to provide you with monthly packets containing a variety of climate information products, as well as your agreement to provide us with feedback about the products, is now complete. We want to sincerely thank you for your thoughtful comments via the surveys and telephone interviews, which were the key ingredient in the project's overwhelming success.

The responses that you have shared with us over the course of the past year have been invaluable, and are allowing us to make concrete contributions to the goal of making forecasts more useful on several important fronts. For one, as the newsletter describes in greater detail, the END InSight Initiative will contribute to the Arizona Drought Task Force's efforts to establish an effective drought plan for Arizona.

Gregg Garfin will present preliminary data and lessons learned from the END InSight Initiative at the North American Drought Monitor workshop, June 25-27, 2003. The folks who created the version of the Drought Monitor map that stretches into Mexico are working on refining the map to make it more user friendly. They are very interested in the feedback some of you gave us a couple of months ago on this map.

We encourage you to take advantage of another opportunity to provide feedback to forecasters: the Climate Prediction Center, which creates the one-month and three-month temperature and precipitation outlooks (included in the forecasts section of your monthly packets), has issued a solicitation for public comments on proposed changes to the probability formats of these products. More information about these proposed changes, and a link to an on-line comment form, are available at http://www.cpc.ncep.noaa.gov/products/predictions/90day/service_change_ll.html.

Despite the completion of the END InSight Initiative, we will continue to make much of the information that has been included in your packets available to you via the CLIMAS Southwest Outlook webpages, at http://www.ispe.arizona.edu/climas/forecasts/swoutlook.html. It remains to be seen whether we will be able to continue some of the other products, such as the newsletter and focus pages. We are also in the process of determining whether the forecasting products will be offered in pdf format in the future, or if only html format will be available.

We look forward to meeting many of you at the July 8 workshop, where we plan to delve more deeply into some of the interesting issues that the END InSight Initiative has raised, and also give you the opportunity to meet with the forecasters and END staff who have been producing the information you've been reviewing.

For those of you who are unable to attend the workshop, we would like to say once again how much we appreciate your participation in the project. We are in the process of compiling a listserv to notify you on a monthly basis when the Southwest Outlook pages are updated, and also to keep you abreast of other developments with the project.

In the mean time, we hope that you enjoy this month's packet. The focus pages cover La Niña and the monsoon, and also include a few experimental climate products for your review. This month's newsletter addresses several drought-related issues, such as an update on the current status of the drought, the various indices that forecasters use to gain information about droughts, and a more detailed explanation of the Arizona drought planning process.

We would greatly appreciate the return of the enclosed *last survey (!)* by **July 2, 2003**, so that we can include those responses in our workshop preparation.

Thanks again for the important role that you have played in the END InSight Initiative!

Best regards,

Evaluation – Monthly Information Packet

For: June 2003 Packet Number: 12

Please complete the following questionnaire about the information packet contents.

1. Does the information provided in this packet (check one):

   ___ confirm your assessment of current climate conditions

   ___ contradict your assessment of current climate conditions

   ___ both confirm and contradict your assessment of current climate conditions

2. Was there information missing from this packet that you would like to receive? (please specify)

3. Did you share or discuss any of the information provided with your co-workers? (please specify their position)

____ Top management ____ Field operations ____ Public relations/Education

____ Middle management ____ Research/Analysis

____ Other (please specify)____

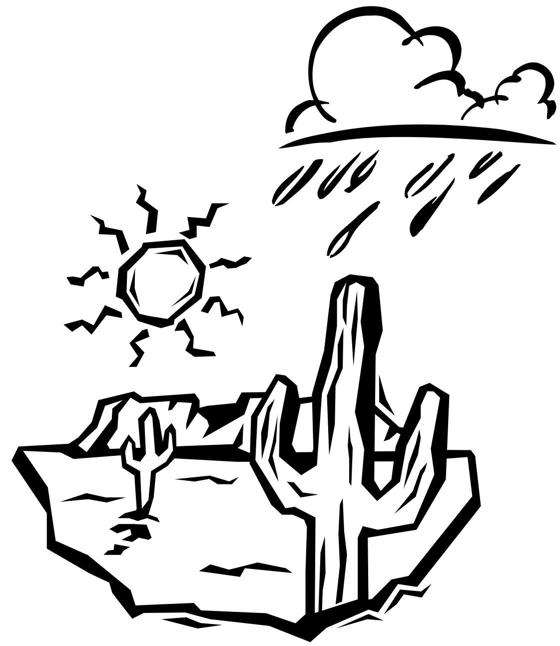
4. Did any of the information we provided have an influence on your organization?

   ____Yes ____No

   If Yes, please specify the information used and how you used it.

5. Do you have any additional comments about the packet or particular information products within it?

END InSight



CLIMAS El Niño-Drought Initiative

Information Packet #12
June 2003

Climate Assessment for the Southwest
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Section A

BACKGROUND

News from the CLIMAS El Niño-Drought Initiative

END InSight

June 2003

THE UNIVERSITY OF ARIZONA®

The Many Dimensions of Drought

Although the first question on most people's minds is, "When is this drought going to be over?," answering this question depends on how one defines drought. Drought has a range of definitions, but a basic one is that, "Drought…originates from a deficiency of precipitation over an extended period of time, usually a season or more. This deficiency results in a water shortage for some activity, group, or environmental sector" (1).

This definition illustrates that drought impacts are a complex function of water sources and water use (2). It also forms the basis of important policy decisions, such as changes in water management, increased implementation of conservation measures, or the release of government assistance to farmers and others whose livelihoods are directly affected.

However, within this basic definition lie gray areas regarding the dimensions of particular droughts and which economic sectors and natural resources are most affected. To deal with this ambiguity, researchers and forecasters have defined several different types of drought: 1) *meteorological,* defined by the degree of dryness compared to average and the duration of the dry period; 2) *agricultural,* wherein meteorological and hydrological drought are linked to agricultural impacts; and 3) *hydrological,* when precipitation shortfalls affect surface or subsurface water supplies (1). These categories are used by the U.S. Drought Monitor to illustrate drought impacts on their weekly maps.

All three drought types can occur simultaneously. For example, within the context of a meteorological drought, agricultural drought is normally the first type to become apparent, particularly in areas that rely heavily on stored soil moisture rather than irrigation. If below-average precipitation continues, hydrological drought and consequent water shortages may become apparent.

Within each of these categories, there are several other key aspects of drought that must also be considered. Five of the most important are: 1) time scale, 2) probability, 3) precipitation deficit, 4) application of the definition to precipitation to different water sources, and 5) the relationship of the definition to the impacts of drought (2).

Drought impacts are a complex combination of water resources and water use. The form of precipitation has important influences for defining drought. Usable water sources include soil moisture, groundwater, snowpack, streamflow and reservoir storage (2). For drought to truly end, each of these water sources must be replenished. Heavy winter rainfall over short periods of time may increase streamflow and reservoir levels to normal levels temporarily, but may do little to replenish soil moisture, and may not entirely compensate for the longer-lasting water supplies that snowpack provides.

Drought Indices

To more effectively understand drought and its impacts (including its beginning and end), researchers have created a variety of indices to measure the depth and type of water deficits. As Michael Hayes of the National Drought Mitigation Center notes, "Drought indices assimilate thousands of bits of data on rainfall, snowpack, streamflow, and other water supply indicators into a comprehensible big picture" (3). Specific indices may be best suited to particular purposes, as the next sections will describe.

Percent of Normal (average): A simple calculation effective for comparing between single regions or seasons. However, since "normal" is a mathematical construct based on a limited number of years, it may not always reflect emerging climatic trends or patterns dominant in the longer climate record. Because precipitation data are frequently characterized by a skewed (non-normal) distribution, average is not always the most accurate measure to describe precipitation characteristics. Important information about the variability of precipitation cannot be discerned by using the percent of normal.

Standardized Precipitation Index (SPI): SPI is an index based on the probability distribution of the long-term precipitation record for a desired period of time. It can be computed for different time scales, allowing for assessment of drought severity in both the short- and long-term and providing early warning of drought. One of the great virtues of SPI is that rigorously tested criteria for drought initiation and termination are an implicit part of the index. Thus it is a favorite among many drought planners. Wet periods can also be monitored using SPI.

Palmer Drought Severity Index (PDSI): The PDSI uses an algorithm to calculate water balance and soil moisture, based on temperature and precipitation inputs; thus it is particularly useful for agricultural applications. It is used by many U.S. government agencies and

continued on page 4

Arizona Begins Drought Planning Process

END InSight Playing a Role

On March 20, 2003 Arizona Gov. Janet Napolitano ordered that Arizona join 35 U.S. states, including New Mexico, that have created formal drought plans. The Arizona Drought Task Force is a direct response to the ongoing drought, while recognizing that droughts are a recurrent feature of the Southwest. The crisis that many rural areas of Arizona are facing is highlighted, along with the idea that adverse drought impacts can be mitigated by proper coordination of activities.

The timing of Gov. Napolitano's decree that Arizona develop a drought plan is most fortuitous with regard to the END InSight Initiative. Although it was not the intention of the Initiative at the outset, a window of opportunity has been opened for providing the Drought Task Force and other interested individuals with the climate information necessary to create an effective drought plan and for continued monitoring and evaluation of drought conditions. Stakeholder input gained through END InSight and other CLIMAS research efforts is expected to contribute to the research, monitoring, and communication aspects of the drought planning efforts and also encourage interaction among agencies, researchers, and the public.

Over the course of the past year, END InSight has made its participants aware of the broad spectrum of available climate information, improved understanding of climate variability and impacts, and raised awareness of the potential role of climate information in resource management and planning. In much the same way, the project will supply the Drought Task Force and the public with accurate and accessible information for planning and monitoring drought conditions. Up-to-date information on drought conditions, climate and weather forecasts, and other pertinent information will be available on the web.

The Drought Task Force website, http://www.water.az.gov/gdtf/, already includes links to the END InSight website. END climate information packets have been distributed and have formed the basis of presentations at drought task force meetings. The Arizona Department of Water Resources, which is heading up the drought planning effort, has expressed interest in providing a streamlined, web-based version of the information provided through the END InSight Initiative. The July 8 "End of END Workshop" in Tempe will provide an opportunity for dialogue between those who produce and those who use climate information and will contribute valuable insights to the drought planning process.

The Arizona drought plan will identify critical water shortage sectors, such as agricultural operations, wildlife, and wildfire, this summer and will implement a short-term drought plan to address needs in these areas. The plan also calls for longer-term drought mitigation, including developing thresholds for declaring a drought emergency. The longer-term effort will recognize and build upon existing drought efforts. It also aims to reduce the impact of drought on economic activities, communities, and habitats throughout the state. A conservation strategy that focuses on education, technology transfer, and assistance will also be developed.

The Drought Task Force includes state agencies and elected officials; representatives of Arizona counties, cities, towns, Indian tribes, water and power utilities, and the public are also being invited to participate. The National Drought Mitigation Center will play a role in shaping the agenda for the Drought Task Force through participation in a workshop scheduled for July 10.

Drought preparation has been formally underway in New Mexico for almost five years. New Mexico began its drought planning process with an Executive Order signed by Gov. Gary Johnson on October 11, 1998. The New Mexico plan emphasizes actions for drought monitoring, assessment, preparedness, mitigation, and assistance. The plan has been edited and expanded several times.

New Mexico's Drought Planning Team produces a meteorological drought status map, available through their website at http://weather.nmsu.edu/drought/droughtstatus.htm. The site also links to CLIMAS' Southwest Climate Outlook, which provides the information from the END InSight packets on the web. The END team will continue to provide this monthly resource in the future. The Southwest Climate Outlook can be accessed directly at http://www.ispe.arizona.edu/climas/forecasts/swoutlook.html.

10 Steps for Drought Planning

1. Appoint a drought task force.
2. State the purpose and objectives of the drought plan.
3. Seek stakeholder participation and resolve conflict.
4. Inventory resources and identify groups at risk.
5. Develop organizational structure and prepare drought plan.
6. Integrate science and public policy, close institutional gaps.
7. Publicize the proposed plan, solicit reaction.
8. Implement the plan.
9. Develop education programs.
10. Post-drought evaluation.

From the National Drought Mitigation Center at the University of Nebraska, Lincoln. For more information on drought planning, see http://www.drought.unl.edu/index.htm.

Drought Update:

Where Do We Stand?

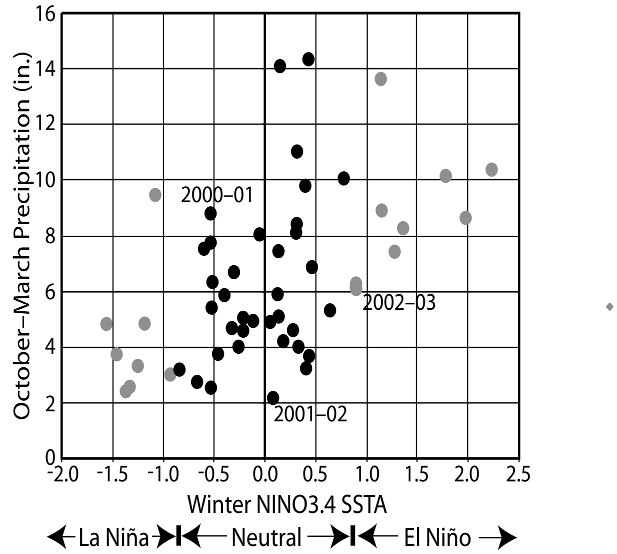

Figure 1. Arizona statewide winter precipitation versus the NINO3.4 sea surface temperature anomaly (SSTA) index for 1951 through 2003. The NINO3.4 SSTA index is a measure of El Niño-Southern Oscillation (ENSO) activity in the equatorial Pacific Ocean. Black dots indicate neutral ENSO conditions and grey dots indicate either El Niño (positive SSTA) or La Niña (negative SSTA) conditons.

This Year vs. Last Year

Drought conditions have improved over most of Arizona and New Mexico—but unfortunately, *improved* is not the same as *ended.* According to the July 16, 2002 Drought Monitor, the entirety of Arizona and New Mexico was experiencing some degree of drought, with most of the northern portions of both states classified as "exceptional" and most of the remainder in extreme drought. Fortunately, conditions in the June 10, 2003 edition of the Monitor show very limited areas of exceptional drought; extreme drought is confined to northern areas of each state; severe to moderate conditions prevail elsewhere.

Despite some improvement, the drought is definitely not over. U.S. Secretary of Agriculture Anne Veneman again declared Arizona a drought disaster area in May of this year, just as she did in May of 2002. The 2003 drought declaration seeks $232 million in federal aid.

Gov. Bill Richardson recently declared a drought-related state of emergency in New Mexico, which makes New Mexico eligible for federal money to spend on firefighting, water supplies, and other forms of drought relief. Rio Grande streamflow and reservoir storage are expected to be at around half of the long-term average this summer.

Snowpack was again far below average in Arizona and New Mexico, and consequently lower-than-average flow is expected on the Colorado River. Lake Powell inflow was estimated in May 2003 to be 57 percent of average, compared to 38 percent in April 2002. Improvements have been more significant in the Salt and Verde river systems: the Salt River was projected to be at 11 percent of average in April 2002, but 109 percent of average in April 2003, and the Verde has gone from 24 percent of average volume to 103 percent in the space of a year (1). These rivers supply Phoenix with about three-quarters of its drinking water. More broadly, to meet the demands of Arizona, Nevada, and California, water managers will have to draw further on water stored in Lakes Mead and Powell.

La Niña Looms Large

Although overall drought conditions in Arizona and New Mexico may be marginally better, the likelihood of the drought ending any time soon is considerably lower than it was at this time last year. In July 2002, when the END InSight Initiative began, an El Niño event was building in the Pacific. El Niño conditions often, but not always, bring greater than average precipitation to the Southwest. As 2002 wore on, this particular ENSO event remained in the moderate range and brought below-average to slightly above-average precipitation to the Southwest.

Currently, sea surface temperatures in the equatorial Pacific Ocean are declining, indicating that a La Niña event may be developing. Whether this La Niña will continue to develop and its likely strength will become evident within the next month or so. La Niña is more consistent in bringing drier weather to the Southwest than El Niño is at bringing wetter conditions (Figure 1). This is particularly true when the Pacific Decadal Oscillation (PDO) is in its negative phase, as it is currently believed to be.

Researchers also have discovered that although recent La Niña events have rarely lasted longer than two years, such conditions have persisted during, and apparently been responsible for, some of the most severe and prolonged droughts in U.S. history (2). For example, a La Niña event that lasted from 1855-1863 coincided with drought across the western United States. Researchers have documented La Niña-related mechanisms through which drier land conditions lead to less evapotranspiration and increased surface temperatures, which can prolong drought further.

So while at this time last year there was some hope that El Niño might break the drought that has gripped much of the Southwest for the past four years or so, such optimism has evaporated. Even if the monsoon rains are above average, the chances of a wet winter of the magnitude that would be required to refill reservoirs, improve grazing conditions, dampen wildfire danger, and revive wildlife habitat are slim.

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(2) Cole, J., J. Overpeck and E. Cook. 2001. Multiyear La Niña events and persistent drought in the contiguous United States. *Geophysical Research Letters,* 29:10.1029/2001G013561, 25-1-4.

Drought Indices, continued

states to trigger drought relief programs. However, PDSI may fail to show emerging droughts for several months and is best suited for areas of the Midwest for which it was developed. Snowfall, snow cover, and frozen ground are not included in the index, so it may be less useful during the winter and spring months.

Crop Moisture Index (CMI): Derived from the PDSI, CMI shows short-term moisture supply across major cropping regions; however, it is not intended for monitoring long-term drought.

Surface Water Supply Index (SWSI): SWSI supplies hydrological elements missing from PDSI, such as mountain snowpack, streamflow, precipitation and reservoir storage on a basin-by-basin basis. SWSI is best suited for "mountain water dependent" areas such Colorado, where it was developed and where it is used in triggering Colorado Drought Plan actions. However, making comparisons between basins is difficult, and water management changes within a basin require that SWSI be redeveloped for that basin.

Reclamation Drought Index (RDI): Similar to SWSI, the RDI incorporates temperature as well as precipitation, snowpack, streamflow, and reservoir levels in order to define drought on a river basin level. The Bureau of Reclamation uses RDI to trigger the release of emergency drought funds, and it is included in the drought plan of the state of Oklahoma.

Deciles: This measure groups the occurrences of precipitation into deciles (tenths of the data distribution), rather than averages. Deciles are subjectively classified into two-decile groupings, such that "much below normal" precipitation is defined as precipitation in the lowest 20 percent of the historical record, and "much above normal" precipitation is in the highest 20 percent of the record. Deciles are easy to calculate, and they provide a statistically accurate measure of precipitation; however, they require a long-term climatic record. Australia uses deciles to determine drought relief for farmers and ranchers, who can only request assistance for droughts of an intensity that occurs only once every 20-25 years and have lasted longer than 12 months.

Drought Monitor: The U.S. Drought Monitor (DM) is a regular feature of the END InSight monthly packets, and it provides a new "index" of drought activity. The DM is a multi-agency collaboration of drought experts that provides a subjective assessment of a wide variety of objective drought indices and drought impact indicators, including many of those mentioned above. One of the great virtues of the weekly DM map is that it is coordinated by national drought experts from several federal agencies and it is informed by input from regional federal, state, and local experts across the country. However, because input is voluntary, there can be occasional under-reporting of sub-regional drought variations.

A New Definition of Drought?
Beyond the various definitions of drought and various ways of measuring it, Kelly Redmond of the Western Regional Climate Center offers a provocative alternative definition of drought: drought occurs when there is insufficient water to meet needs. This definition takes both supply and demand factors into account, making drought more than merely a meteorological deviation from average precipitation. Thus, using this definition, drought frequency and severity will probably increase in the West regardless of climatic patterns as long as rapid population growth and increased demands on water supplies continue. Indeed, under this definition many rural communities and increasing numbers of urban ones may find themselves in perpetual drought (4).

–Rebecca Carter, CLIMAS

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(3) Hayes, M. Drought indices. National Drought Mitigation Center. Accessed at http://www.drought.unl.edu/whatis/indices.htm on May 27, 2003.

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About END InSight

END InSight is a year-long project to provide stakeholders in the Southwest with information about current drought and El Niño conditions. As part of the Climate Assessment for the Southwest (CLIMAS) project at the University of Arizona, END InSight is gathering feedback from stakeholders to improve the creation and use of climate information.

The *END InSight Newsletter* is published monthly and includes background and topical climate information. All material in the newsletter may be reproduced, provided CLIMAS is acknowledged as the source. The newsletter is produced with support from the National Oceanic and Atmospheric Administration (NOAA).

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Executive Summary, June 2003

- ***Hydrological drought*** will continue to be a major concern for the Southwest during the upcoming months.
  - The New Mexico Drought Monitor Committee has declared ***emergency status for most New Mexico river basins, including the Rio Grande and the Pecos.***
  - Lake Mead is at its lowest level since July 1969.

- Large fires have exploded across Arizona during the past month. ***Fire danger*** is above average across all of ***Arizona*** and is especially high at elevations lower than 8,500 feet.

- New Mexico and Arizona continue to have the ***poorest range and pasture conditions*** (relative to state averages) in the United States.

- Seasonal temperature forecasts indicate ***increased probabilities of above-average temperatures across Arizona and most of New Mexico*** for the next year.

- There is ***increased uncertainty in ENSO forecasts.*** Eastern Pacific Ocean temperatures remain cooler than average; however, the chances of ***La Niña*** developing are less than they were one month ago. ***La Niña*** often brings warm, dry winter conditions to the Southwest.

- **Bottom line:** ***Drought will continue in the Southwest during the next several months.***
  - The ***most likely scenario*** is that summer rainfall will be average to above average, bringing relief to some areas. Neutral-to-cool (La Niña) Pacific Ocean temperatures will persist beyond the summer, resulting in average to somewhat below-average autumn and winter precipitation. Water supply and streamflow will continue to be of concern for the foreseeable future. A mild tropical storm season is expected for the Southwest.
  - The ***worst case scenario*** is that the Southwest summer monsoon will arrive late, prolonging the fire season, and will not produce sufficient moisture to relieve short-term drought. Above-average temperatures will increase evaporation rates, resulting in rangeland degradation, as well as decreases in reservoir and groundwater levels. CLIMAS research shows that summer rainfall has seldom ended severe sustained drought (see END InSight Newsletter, August 2002). In the long-term, La Niña will strengthen and winter precipitation will be *well below* average, further reducing reservoir and groundwater levels.
  - The ***best case scenario*** is that in the short-term the Southwest will receive abundant summer rainfall and high fire danger will be quickly abated, although severe erosion will be increased by powerful monsoon storms. In the long-term, La Niña conditions will dissipate or El Niño conditions will rebound this fall, bringing above-average fall and winter precipitation. Reservoir and groundwater levels will be maintained at current levels or increase.

The climate products from the END InSight packet are also available on the web:

END InSight homepage: http://www.ispe.arizona.edu/climas/end/packets.html (pdf version)
CLIMAS Southwest Outlook: http://www.ispe.arizona.edu/climas/forecasts/swoutlook.html

Glossary of Terms

Acre-foot: The volume of water that would cover one acre of land (43,560 square feet) to a depth of one foot, equivalent to 325,851 gallons of water. An acre-foot is the basic measure of agricultural water use.

Aerial Sketch Mapping: An efficient and economical method of detecting and monitoring forest health over large areas by mapping surface conditions from an aerial survey.

Anomaly: Difference between a given quantity or observation and its average value. This is the same as "departure from average." For example, if the average rainfall for June is 5 inches, but this year there is 100 inches of rainfall in June, then the anomaly is +95 inches.

Aquifer: Porous, water-saturated subsurface layers of sand, gravel, and rock that can yield an economically significant amount of water.

CL: see Climatological Probabilities.

Climate: The general or typical atmospheric conditions for a place and/or period of time. Conditions include rainfall, temperature, thunderstorms, lightening, freezes, etc.

Climate Division: A region within a state that is reasonably homogeneous with respect to climatic and hydrologic characteristics. Arizona is divided into 7 climate divisions and New Mexico, into 8.

Climate Prediction Center (CPC): A branch of the National Oceanographic and Atmospheric Agency (NOAA) whose mission is to assess and forecast the impacts of short-term climate variability. The CPC produces official U.S. climate forecasts.

Climatological Probabilities (CL): In CPC forecasts, CL denotes areas for which no anomaly prediction is offered. A default guess of 33.3% chance of above-average, a 33.3% chance of average, and a 33.3% chance of below-average conditions is offered based on the historical probabilities of the period 1971-2000. This notation is being replaced by Equal Chances (EC).

CMI: See Crop Moisture Index.

CNA: See Comisión Nacional de Aqua.

Comisión Nacional de Aqua (CNA): The Mexican water commission.

Cooling Degree Day: A quantitative index that reflects demand for energy to cool homes and businesses. A mean daily temperature of 65°F is the base for cooling degree day computations. Cooling degree days are summations of positive differences from the 65°F base. Thus, a day with a temperature of 72°F would count as 7 cooling degree days. Days with the following temperatures, 72, 71, 75, would result in 23 cooling degree days.

CPC: See Climate Prediction Center.

Crop Moisture Index (CMI): The CMI is derived from the Palmer Drought Severity Index and shows short-term moisture supply across major agricultural regions.

Cutoff low: Upper atmosphere low-pressure system that originates as part of a low-pressure trough but becomes displaced to the south and cut off from the main west-to-east wind flow. Cutoff lows may be associated with precipitation and flooding.

Deciles: A categorization tool that groups the occurrences of precipitation (or temperature or any other measurement) into deciles (tenths of the data distribution).

Degree Day: A quantitative index that reflects demand for energy to heat or cool homes and businesses. A mean daily temperature of 65°F is the base for both heating and cooling degree day computations. Heating degree days are summations of negative differences between the mean daily temperature and the 65°F base; cooling degree days are summations of positive differences from the same base.

Discharge: The volume of water that flows in a given period of time. It commonly is measured in cubic feet per second (cfs) or in cubic meters per second (m^3s^{-1}). One m^3s^{-1} equals about 35 cfs.

Drought: There is no definitive definition of drought based on measurable processes; scientists evaluate precipitation, temperature, and soil moisture data for the present and recent past to determine drought status. Very generally, it refers to a period of time when precipitation levels are low, impacting agriculture, water supply, and wildfire hazard.

Dry Season: A designation used in IRI forecasts for areas experiencing a period of time when conditions are normally dry (less than 3 cm of precipitation); the IRI refrains from giving a forecasts for these regions because of the high variability of precipitation.

EC: See Equal Chances.

El Niño: Refers to a sustained warming of sea surface temperatures (SSTs) across a broad region of the eastern and central tropical Pacific Ocean. This tends to be associated with drier winters in the Pacific Northwest and wetter winters in the Southwest United States. El Niño events are also called warm events.

El Niño Southern Oscillation (ENSO): The term currently used by scientists to describe basin-wide changes every 2 to 7 years in air-sea interaction in the equatorial Pacific Ocean. El Niño/La Niña is the oceanic component and the Southern Oscillation is the atmospheric component of the phenomenon.

ENSO: See El Niño-Southern Oscillation.

Equal Chances (EC): In CPC forecasts, EC denotes areas for which no anomaly prediction is offered. A default guess of 33.3% chance of above-average, a 33.3% chance of average, and a 33.3% chance of below-average conditions is offered based on the historical probabilities of the period 1971-2000. This notation replaces the Climatological Probabilities (CL) notation.

Flood: Any relatively high streamflow event that overflows the natural or artificial banks of a river or stream.

Forecast: A prediction of future conditions by analysis of data. For example, precipitation forecasts are based on meteorological data.

Global Climate Models: Sophisticated computer models of the atmosphere and oceans that attempt to include all the processes known to affect climate.

Groundwater: The water stored in aquifers.

Groundwater Mining: When discharge from an aquifer, usually due to groundwater pumping for municipal and business use, exceeds recharge.

Heating Degree Day: A quantitative index that reflects demand for energy to heat homes and businesses. A mean daily temperature of 65°F is the base for heating degree day computations. Heating degree days are summations of negative differences between the mean daily temperature and the 65°F base. Thus, a day with a temperature of 62°F would count as 3 heating degree days. Days with the following temperatures, 62, 61, 55, would result in 17 heating degree days.

Historical Flood: Flood events documented by human observation but recorded prior to the development of systematic streamflow measurements.

Hydrograph: Graph of variation of stream flow over time.

Infiltration Rate: The amount of water that is absorbed by soils in an amount of time (e.g., millimeters of water absorbed per hour or mm/hr).

Interpolate: To estimate values between measured values, usually using a mathematical function. Spatial interpolation involves estimating values on a map.

IRI: The International Research Institute for Climate Prediction; housed at Columbia University's Earth Institute. Its mission is to accelerate the ability of societies worldwide to cope with climate, especially those events that cause devastating impacts to humans and the environment.

La Niña: Refers to a sustained cooling of sea surface temperatures (SSTs) across a broad region of the eastern and central tropical Pacific Ocean. This tends to be associated with wetter winters in the Pacific Northwest and drier winters in the Southwest United States. La Niña events are also called cold events.

Monsoon: A wind system that reverses its direction seasonally. In the North American Monsoon system, summer winds from the south bring moisture and rainfall to the Southwest United States.

NAO: See North Atlantic Oscillation.

North Atlantic Oscillation (NAO): The NAO is the dominant mode of winter climate variability in the North Atlantic region ranging from central North America to Europe and into much of Northern Asia. The NAO is a large scale seesaw in atmospheric mass between the subtropical high and the polar low.

Oxygen Isotope Records: Records of the effect of salinity and temperature on oxygen chemistry of, for example, growth rings in corals provide a proxy record of past climate conditions.

Pacific Decadal Oscillation (PDO): A long-term El Niño-like pattern of North Pacific climate variability, with phases that persist from 20-30 years. The positive (warm) phase of the PDO is characterized by cooler than average SSTs and air pressure near the Aleutian Islands and warmer than average SSTs near the California coast; these conditions tend to enhance El Niño teleconnections. The negative (cool) phase tends to enhance La Niña teleconnections (i.e., winter wetness in the Pacific Northwest and winter dryness in the Southwest United States).

Pacific/North American Teleconnection Pattern (PNA): Variability in atmospheric pressure over the Northern Pacific and North America is associated with variability in rainfall in the southwestern United States. Wetter summers are associated with PNA phases with strong North to South pressure gradients. Drier summers have tended to follow PNA phases with weak North to South pressure gradients.

Paleoflood: A past or ancient flood event that occurred prior to the time of human observation or direct measurement by modern hydrological procedures.

Palmer Drought Severity Index (PDSI): An indicator, based on temperature, precipitation, and soil type, of long-term deficits or surpluses of soil moisture.

Palmer Hydrological Drought Index (PHDI): An indicator, based on impacts such as groundwater and reservoir levels, of long-term, hydrological drought.

PDO: See Pacific Decadal Oscillation.

PDSI: See Palmer Drought Severity Index.

Peaks-Above-Base: All of the flow events of a size greater than the base flood flow for a particular gauging station.

Percent of Normal (Average): A comparison of conditions, such as precipitation or temperature, at any one place or time with the historical average of that condition.

PHDI: See Palmer Hydrological Drought Index.

Phenology: A branch of science dealing with the relations between climate and periodic biological phenomena, such as bird migration or plant flowering.

PNA: See Pacific/North American teleconnection.

Precipitation: Rainfall, snow, sleet, hail, etc.

Precipitation Intensity: The maximum amount of precipitation in a period of time (e.g., I_{30} is the maximum precipitation over thirty minutes). Precipitation intensity can be related to discharge.

RDI: See Reclamation Drought Index.

Recharge: Net accumulation of water into an aquifer from sources such as precipitation, seepage, and injection.

Reclamation Drought Index (RDI): Similar to the Surface Water Supply Index, the RDI incorporates temperature as well as precipitation, snowpack, stream flow, and reservoir levels in order to define drought on a river basin level.

Ridge: An elongated area of high pressure.

Sea Surface Temperature Anomalies (SSTAs): Difference between the measured sea surface temperature at any given time and place and the mean (average) sea surface temperature.

Servicio Meteorológico Nacional (SMN): The Mexican meteorological agency.

SMN: See Servicio Meteorológico Nacional.

SNOTEL (SNOpack TELemetry): A near real-time hydrometeorological data collection network in the West that collects SWE, precipitation, and temperature data from nearly 600 remote high-elevation stations.

Snowpack: A horizontally layered accumulation of snow from snowfall events, which may be modified by meteorological conditions over time.

Snow water content (SWC): How much liquid water is contained in a volume of solid snow (in other words, how much water would be measured if a known amount of snow was melted). Snow water content and snow water equivalent are different terms for the same parameter.

Snow water equivalent (SWE): How much liquid water is contained in a volume of solid snow (in other words, the amount of water measured from melting a known amount of snow). Snow water content and snow water equivalent are different terms for the same parameter.

SPI: See Standard Precipitation Index.

SSTs: Sea surface temperatures.

Standard Precipitation Index (SPI): An index of soil moisture that considers both the long-term average and recent precipitation (up to the last 72 months).

Surface Water Supply Index (SWSI): The SWSI is similar to the Palmer Drought Severity Index but also includes hydrological elements such as mountain snowpack, stream flow, precipitation, and reservoir storage on a basin-to-basin basis, making it very useful in "mountain water dependent" areas.

SWC: See Snow water content.

SWSI: See Surface Water Supply Index.

SWE: See Snow water equivalent.

Teleconnections: Atmospheric interactions between widely separated regions that have been identified through statistical correlations (in space and time). For example, the El Niño teleconnection with the Southwest United States involves large-scale changes in climatic conditions that are linked to increased winter rainfall.

Trough: An elongated area of low pressure.

Vegetation and Temperature Condition Index (VT): A numerical index of vegetation health that ranges from 0 (extremely poor) to 100 (excellent). It reflects, indirectly, a combination of chlorophyll (photosynthetic plant material) and moisture content in vegetation, as well as thermal conditions at the surface.

VT: See Vegetation and Temperature Condition Index.

Water Supply Outlook: A summary of snowpack, reservoir, stream flow, and precipitation for watersheds and basins, which is available bi-monthly from January through April from the U.S. Department of Agriculture's National Resources Conservation Service.

Water Year: The water year begins on October 1 and ends on September 30 of the following year. For example water year 1994 began October 1, 1993 and ended September 30, 1994.

Weather: Describes the daily conditions (individual storms) or conditions over several days (week of record-breaking temperatures) to those lasting less than two weeks.

Wildland Urban Interface: A term that refers to houses that are built close to or within forested areas.

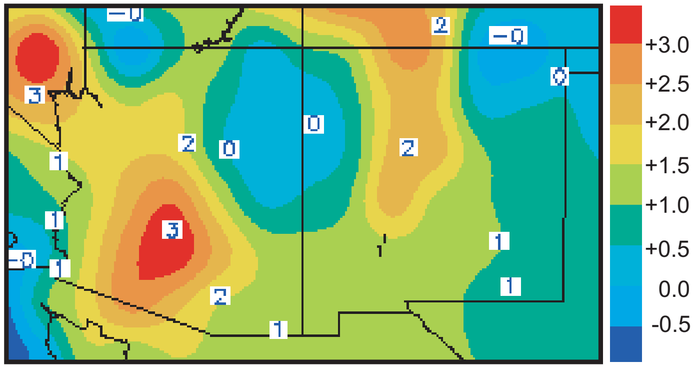
Wind stress: The force per unit area that wind exerts on the surface of the ocean.

Section B

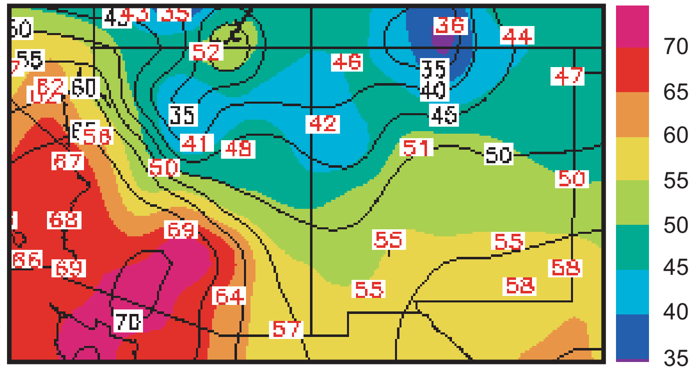
RECENT CONDITIONS

1. Recent Conditions: Temperature (up to 06/18/03) Source: Western Regional Climate Center

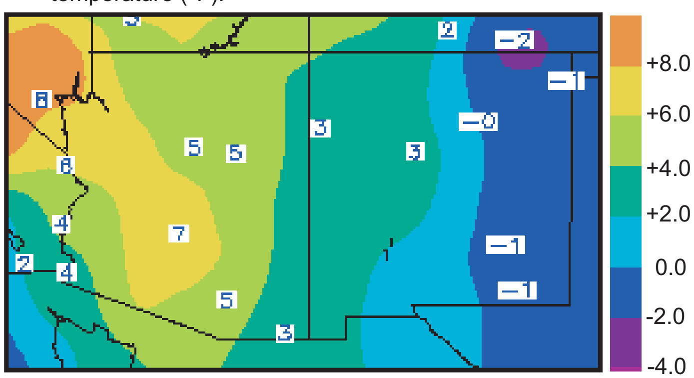
1a. Water year '02-'03 (through 6/18) departure from average temperature (°F).



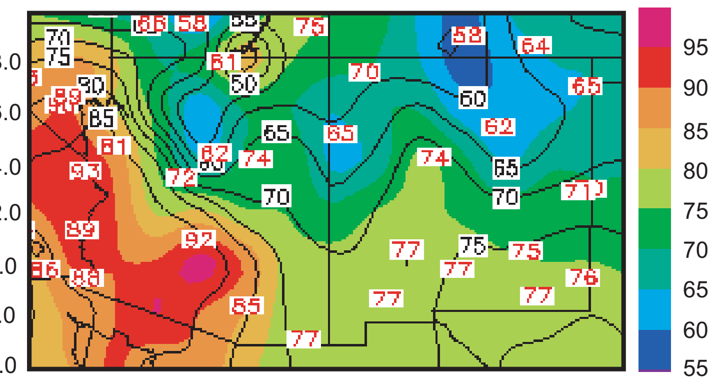
1b. Water year '02-'03 (through 6/18) average temperature (°F).



1c. Previous 28 days (5/22 - 6/18) departure from average temperature (°F).



1d. Previous 28 days (5/22 - 6/18) average temperature (°F).



Highlights: During the past month, there have been consistent above-average temperatures across much of Arizona and western New Mexico. Eastern New Mexico has experienced slightly below-average temperatures (Figures 1c and 1d). Large parts of the region have been experiencing above-average temperatures since the water year began in October 2002 (Figures 1a and 1b). Above-average temperatures have been most noteworthy in central Arizona. Only the Four Corners region and eastern New Mexico have been at near-average temperatures since October 2002. The overall above-average regional temperatures add to the risk of wildfire in the Southwest this summer.

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).

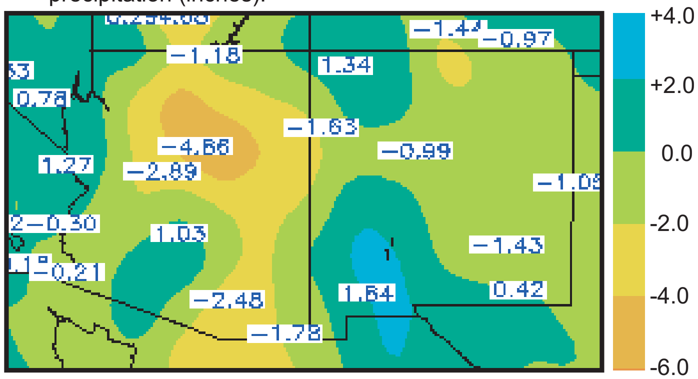
Departure from average temperature is calculated by subtracting current data from the average and can be positive or negative.

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.

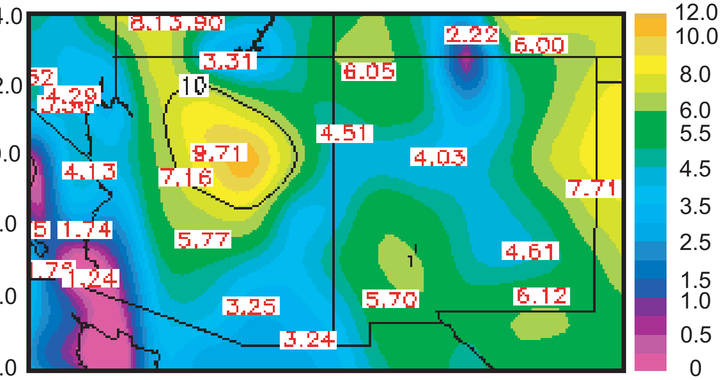
The red and blue numbers shown on the maps represent individual stations. The contour lines and black numbers show average temperatures.

2. Recent Conditions: Precipitation (up to 06/18/03) Source: Western Regional Climate Center

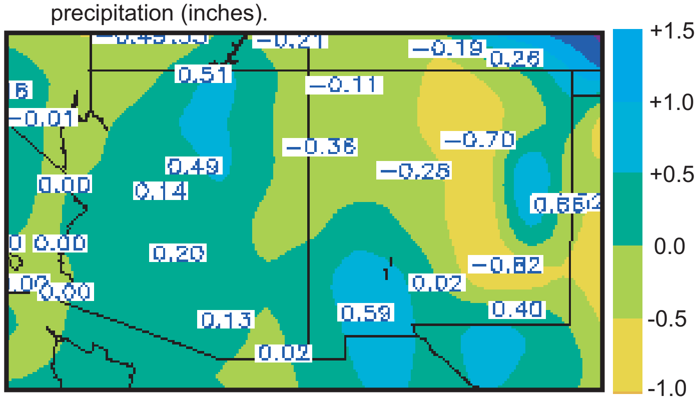
2a. Water year '02-'03 (through 6/18) departure from average precipitation (inches).



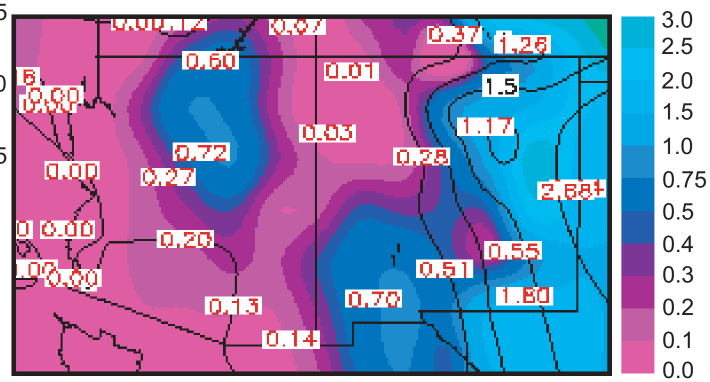
2b. Water year '02-'03 (through 6/18) total precipitation (inches).



2c. Previous 28 days (5/22 - 6/18) departure from average precipitation (inches).



2d. Previous 28 days (5/22 - 6/18) total precipitation (inches).



Highlights: Most of both Arizona and New Mexico have received below-average precipitation since October 1, 2002 (Figure 2a), with some areas in Arizona experiencing greatly reduced precipitation over this period of time. During the past month, much of New Mexico has received over a half-inch of precipitation and has experienced some short-term drought relief (see Page 5 for more information). Most of Arizona, however, has been very dry over the past month (Figure 2d). Dry conditions in Arizona have contributed to the number of wildfires occurring across the state (see Page 15 for more information) and concerns about soil erosion and poor range conditions this summer.

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.

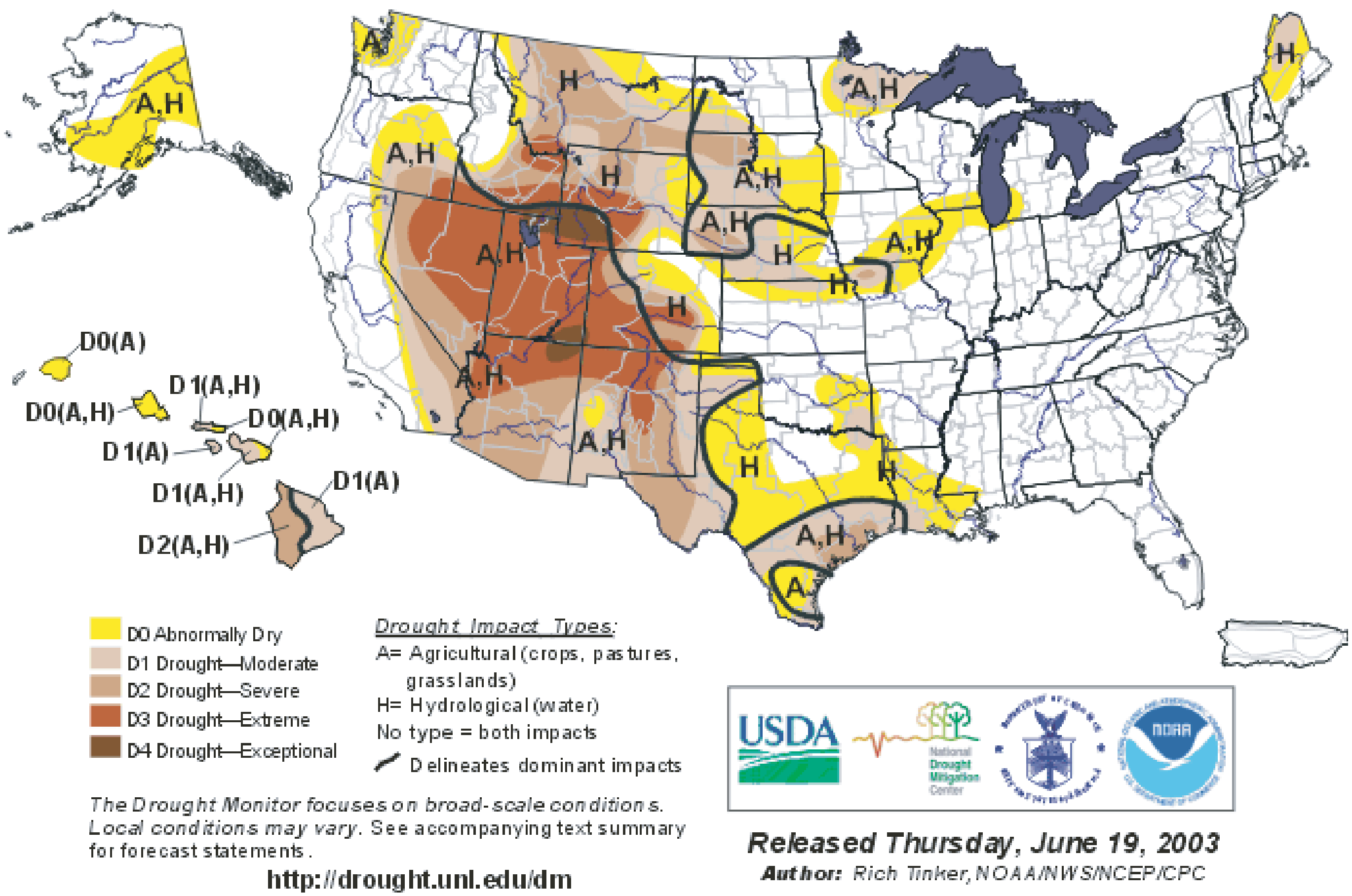
The data are in inches of precipitation. **Note: The scales for Figures 2b & 2d are non-linear.**

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 06/17/03) ♦ 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 06/19 and is based on data collected through 06/19 (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.

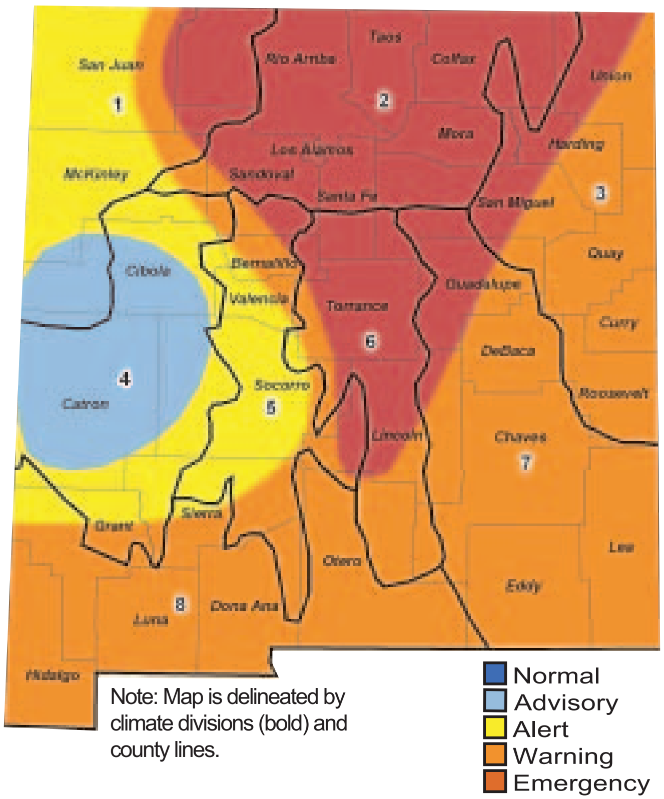
Highlights: Drought area has increased across central and southeastern Arizona and central New Mexico since late May 2003. Of particular note are the following: the return of an area of exceptional drought to northeastern Arizona, an expansion in the area of extreme and severe drought throughout central and southeastern New Mexico, and an expansion of severe drought across central and southern Arizona. The USDA reports that 50% of Arizona pasture and rangeland is in poor-to-very poor condition and only 22% is in good or excellent condition. For New Mexico, 66% of pasture and rangeland is in poor-to-very poor condition and only 5% is in good or excellent condition. Irrigated crops in both states were in mostly fair-to-good condition, with New Mexico pecans reported to be in fair to excellent condition. Long-term (hydrological) drought conditions remain of concern across our region. Of special concern is the fact that New Mexico streamflow has been far below forecasted levels, even after taking into account extreme soil moisture deficits (see page 7).

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 06/17/03) ♦ Source: New Mexico NRCS

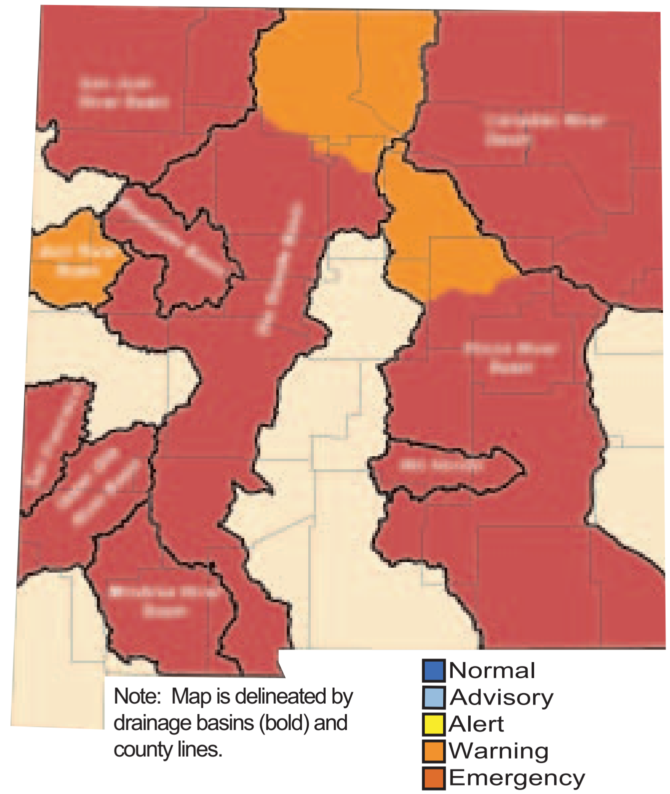
Meteorological Drought Map

Drought Status as of June 17, 2003



Hydrological Drought Map

Drought Status as of June 17, 2003



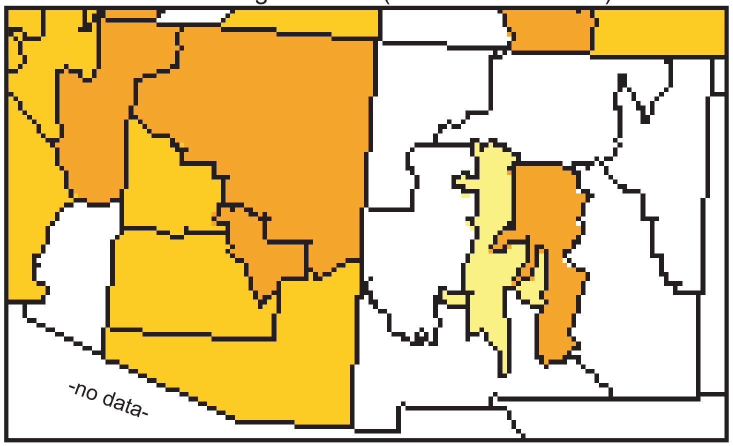
Notes: New Mexico drought status maps are updated by the New Mexico Natural Resource Conservation Service (NRCS) in conjunction with the New Mexico Drought Planning Team. As of April of 2003, drought status is mapped as short-term *meteorological* drought (left) and as long-term *hydrological* drought (right). In addition to the use of more than one map to represent drought conditions, the switch to two drought maps included 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 the development of an Arizona drought status map from the recently created Arizona Drought Task Force.

Highlights: Few changes were made to the drought maps from last month. According to a preliminary statement from the New Mexico Drought Planning Team, meteorological drought emergency status has been extended southward, farther into Lincoln County along the central mountain chain. On the hydrological map, the upper Rio Grande river basin (i.e., the Bluewater and Zuni basins) has been downgraded from emergency to warning status due to recent rains in the area improving soil moisture conditions. Also, the Upper Gila and the San Francisco drainage basins were upgraded from warning to emergency status.

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.

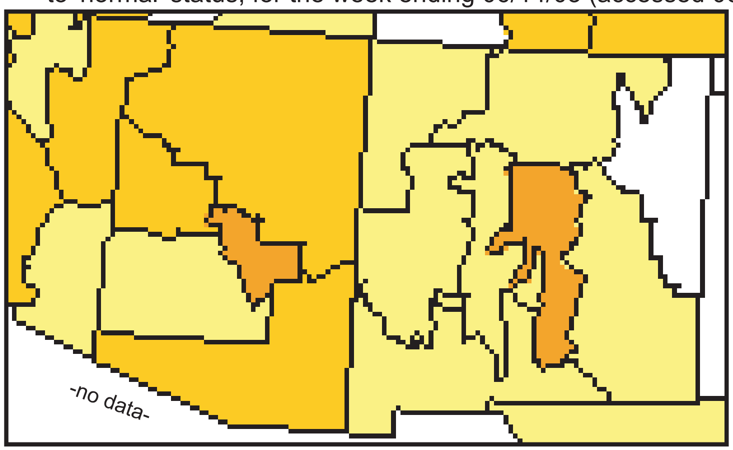
5. PDSI Measures of Recent Conditions (up to 06/14/03) ♦ Source: NOAA Climate Prediction Center

5a. Current weekly Palmer Drought Severity Index (PDSI), for the week ending 06/14/03 (accessed 06/19/03).



- -4.0 or less (extreme drought)
- -3.0 to -3.9 (severe drought)
- -2.0 to -2.9 (moderate drought)
- -1.9 to +1.9 (near normal)

5b. Precipitation needed to bring current weekly PDSI assessment to 'normal' status, for the week ending 06/14/03 (accessed 06/19).



- Zero inches
- Trace to 3 inches
- 3 to 6 inches
- 6 to 9 inches

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.

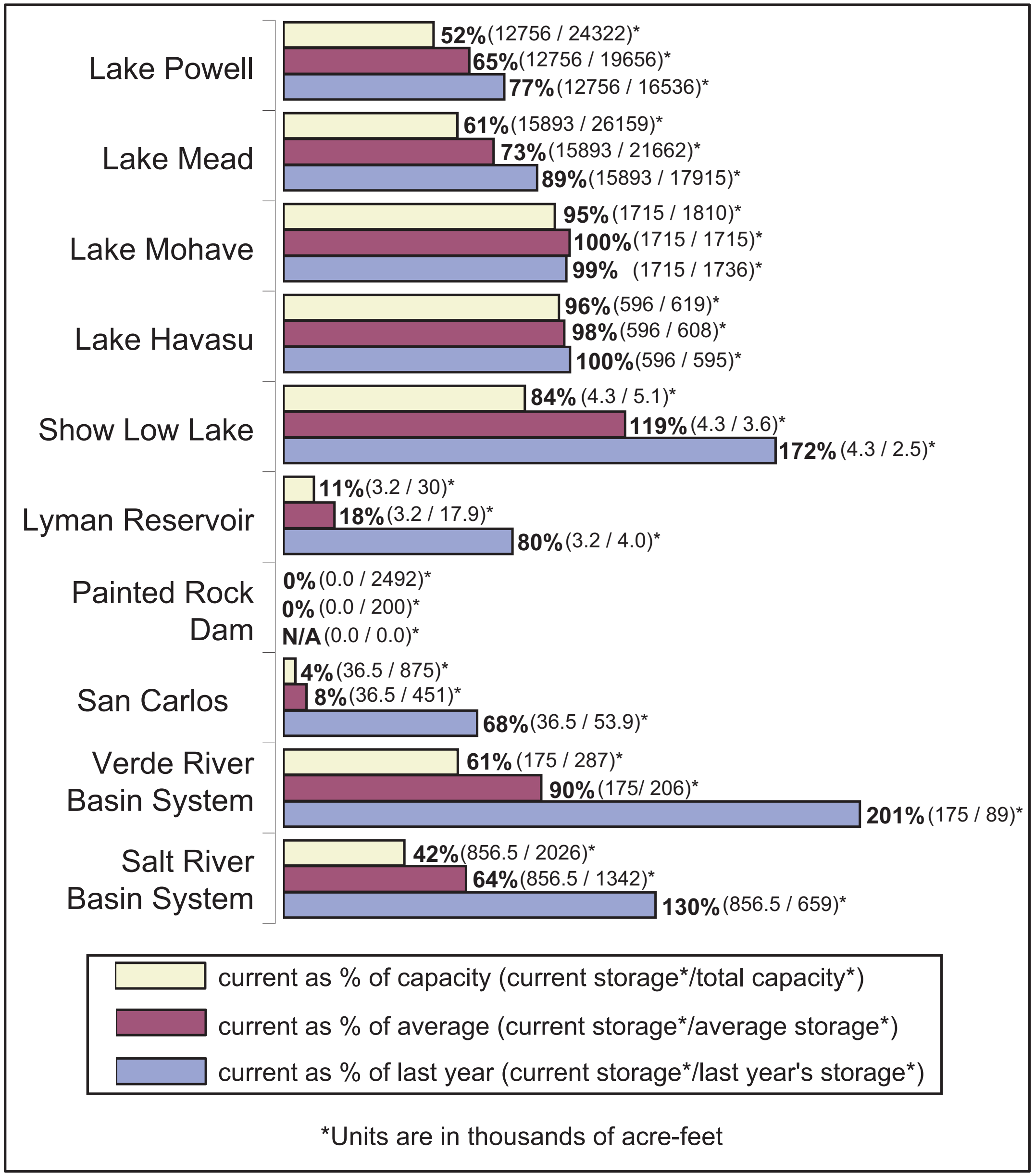
These maps are issued weekly by the NOAA CPC.

Highlights: Compared with conditions a month ago, short-term drought has increased substantially in much of Arizona and remained mostly unchanged in New Mexico (Figure 5a). Rainfall during the past month has stabilized short-term drought conditions over most of New Mexico, keeping conditions at near normal. The amount of precipitation necessary to ameliorate meteorological drought conditions has increased for much of Arizona and parts of New Mexico, compared to last month.

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 May 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 06/14/03, Arizona's report had been updated through the end of May.

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)

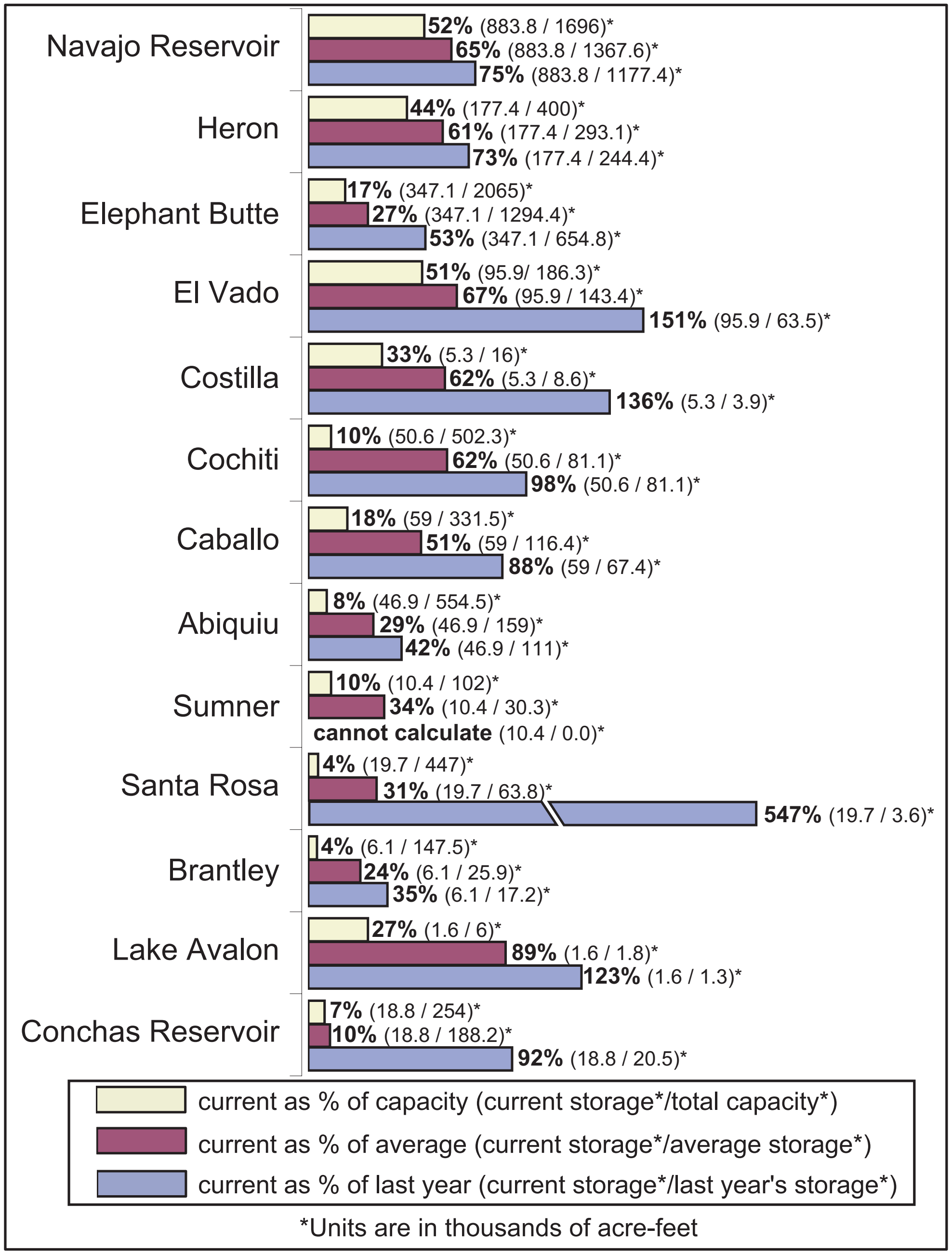
Highlights: Arizona reservoir levels held steady or decreased slightly since last month. Of particular note are decreases in the Verde River Basin System, San Carlos Reservoir, Lake Powell, and Lake Mead.

On June 7, 2003 the *Arizona Republic* reported that Lake Mead receded to its lowest level since July 1969. Both Lake Mead and Lake Powell are expected to lose water this summer, due to a combination of low inflows and legally mandated outflows at levels that exceed inflows.

Flagstaff, Arizona remained under water restrictions that limit sprinkler use to three days a week (*Albuquerque Journal*, June 15, 2003).

Phoenix-area restaurants are being encouraged to conserve water by serving water to patrons on request only (*Arizona Republic*, June 19, 2003).

7. New Mexico Reservoir Levels (through the end of May 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 06/14/03, New Mexico's report has been updated through the end of May.

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)

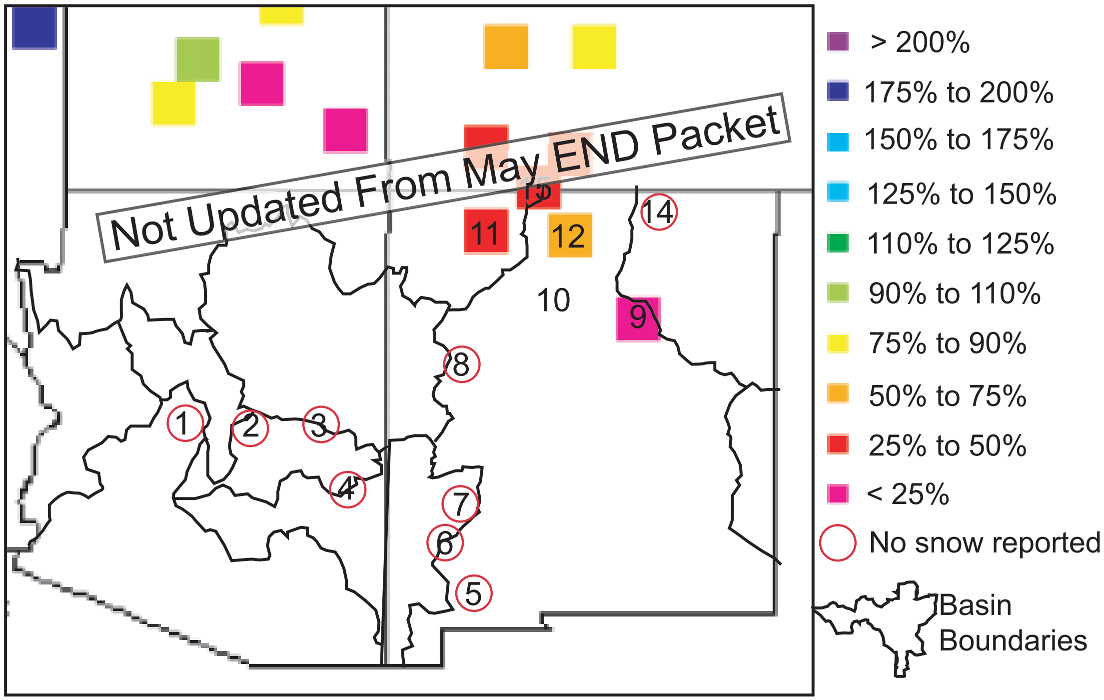
Highlights: New Mexico reservoir levels have overall declined since last month, with Cochiti, Caballo, Abiquiu, and Brantley reservoirs decreasing their current storage relative to average storage levels. Levels in El Vado reservoir, on the other hand, are up substantially since May.

The persistence of drought, the forecast of below-average stream flow, and the low reservoir levels in New Mexico, particularly in mountainous northern areas that had above-average snowpack this past winter and close-to-average water year precipitation, may seem counterintuitive. However, despite some short-term green-up in some areas, most of New Mexico likely will continue to experience drought conditions due to extreme soil moisture deficits.

A recent U.S Circuit Court of Appeals decision in mid-June upholds a ruling last year that gave the U.S. Bureau of Reclamation discretion to cut water deliveries to farmers and cities in New Mexico in order to comply with the Endangered Species Act and protect the endangered silvery minnow in the Rio Grande. This decision is expected to affect water levels in the Rio Grande and the Heron Reservoir, about 20 miles south of the Colorado-New Mexico border (Associated Press, June 14, 2003).

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

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

Highlights: As of June 19, 2003, the snowpack at all SNOTEL monitoring sites in Arizona and New Mexico has diminished to below recordable amounts. As a result, Figure 8 has not been updated from the May END packet. Maps of percent of average snow water content (SWC) data are provided by the Western Regional Climate Center (WRCC) from October-November through May, depending on fall snowfall and spring snowpack conditions. The NRCS Water and Climate Center provides the SNOTEL data for the WRCC maps.

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.

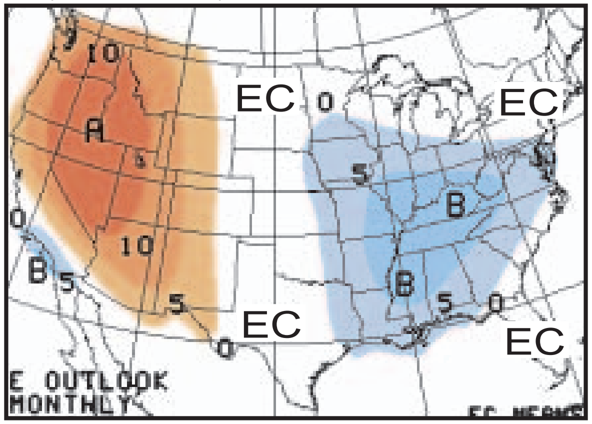
These data are provisional and subject to revision. They have not been processed for quality assurance. However, they provide the best available land-based estimates during the snow measurement season.

Section C

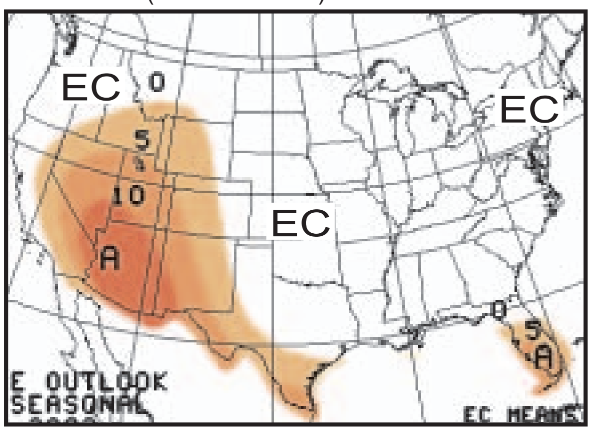
FORECASTS

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

9a. July 2003 U.S. temperature forecast (released 06/19).



9b. July - September 2003 U.S. temperature forecast (released 06/19).



Percent Likelihood of Above and Below Average Temperatures*

dark orange	10% - 20%	
orange	5% - 10%	A = Above
light orange	0% - 5%	
light blue	0% - 5%	B = Below
blue	5% - 10%	

*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.

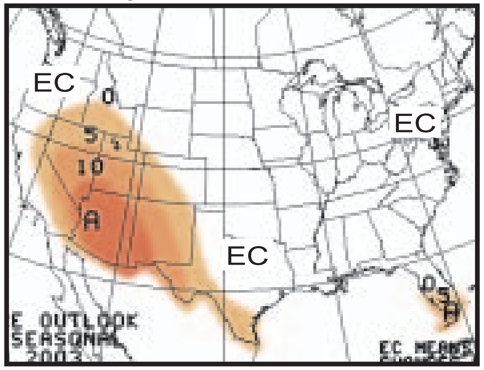
Highlights: The NOAA-CPC temperature outlook for July (Figure 9a) indicates increased probabilities (38% to 53% likelihood) of above-average temperatures for the West, with the highest forecast confidence in Nevada and north of Nevada; the likelihood of increased temperatures in Arizona and New Mexico is between 38% and 43%. The CPC July-September seasonal outlook (Figure 9b) is similar to the July outlook, although greater likelihood of above-average temperatures in Arizona and New Mexico are indicated (38% to 53%). The CPC predictions are based chiefly on historical La Niña impacts on the Southwest and long-term temperature trends. NOAA-CPC climate outlooks are released on the Tuesday 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/

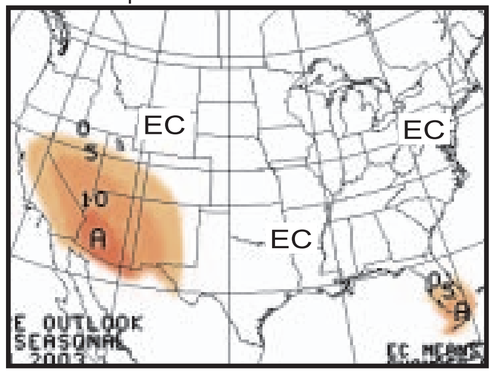
10. Temperature: Multi-season Outlooks ♦ Source: NOAA Climate Prediction Center

Overlapping 3-month long-lead temperature forecasts (released 06/19/03).

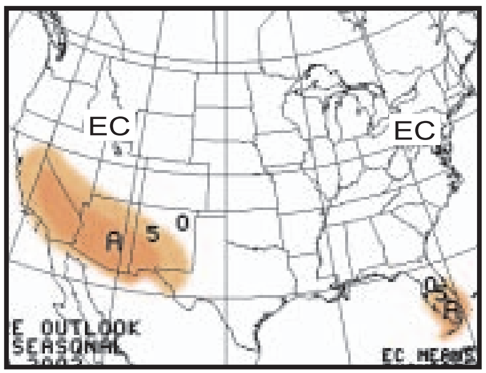
10a. Long-lead national temperature forecast for August - October 2003.



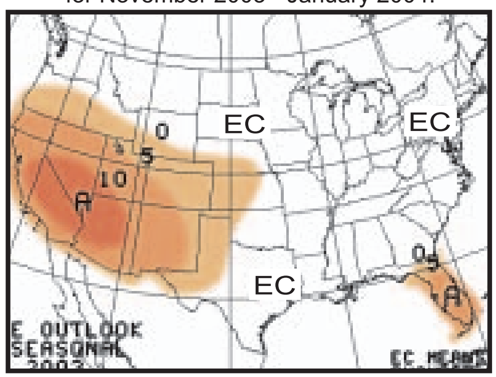
10b. Long-lead national temperature forecast for September - November 2003.



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



10d. Long-lead national temperature forecast for November 2003 - January 2004.



Percent Likelihood of Above and Below Average Temperatures*

10% - 20%

5% - 10%

0% - 5%

A = Above

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

Highlights: The NOAA-CPC temperature outlooks for August 2003 through January 2004 show persistent increased probabilities of above-average temperatures for most of the Southwest (Figures 10a-d). Maximum forecast confidence is centered over Arizona for these seasonal outlooks, and the likelihood of above-average temperatures reaches 43% to 53% over Arizona for most of the fall and early winter. The CPC predictions are based chiefly on historical La Niña impacts on the Southwest and long-term temperature trends. IRI temperature forecasts (*not pictured)* also indicate an enhanced probability for above-average temperature for parts of Mexico and adjacent southwestern United States.

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.

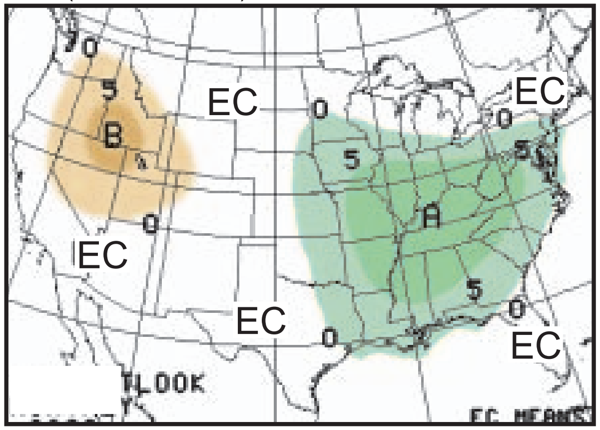
Thus, using the NOAA CPC excess likelihood forecast, in areas with light brown shading (0-5% excess likelihood of above average) there is a 33.3-38.3% chance of above-average, a 33.3% chance of average, and a 28.3-33.3% chance of below-average temperature.

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

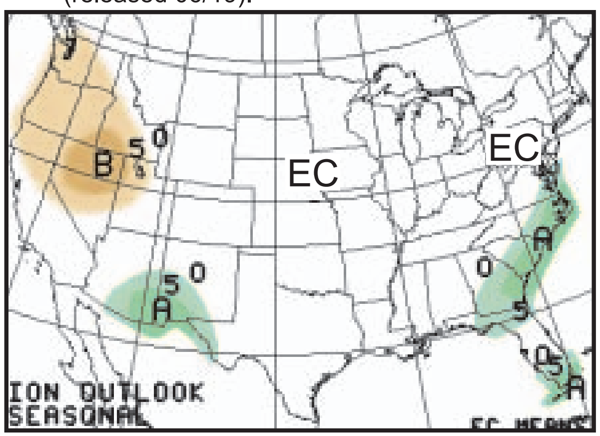
Equal Chances (EC) indicates areas where reliability (i.e., the 'skill') of the forecast is poor and no anomaly prediction is offered.

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

11a. July 2003 U.S. precipitation forecast (released 06/19).



11b. July - September 2003 U.S. precipitation forecast (released 06/19).



Percent Likelihood of Above or Below Average Precipitation*

5% - 10%	A = Above	
0% - 5%		
0% - 5%	B = Below	
5% - 10%		

*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.

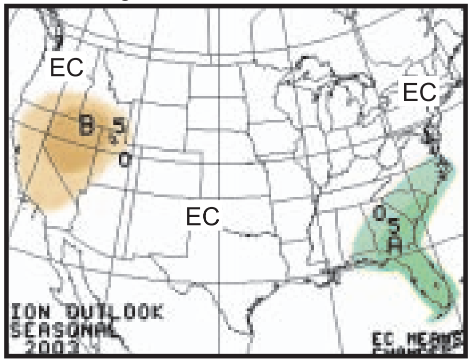
Highlights: The NOAA-CPC has reserved judgment in the precipitation outlook for July for the Southwest (Figure 11a), a month when precipitation in the Southwest can be unpredictable. The outlook for July-September, however, indicates increased probabilities (up to 43% increased likelihood) of above-average precipitation in southeastern Arizona and southwestern New Mexico (Figure 11b). The July-September precipitation forecast from the International Research Institute (IRI) for Climate Prediction (*not pictured)* concurs with this forecast.

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/

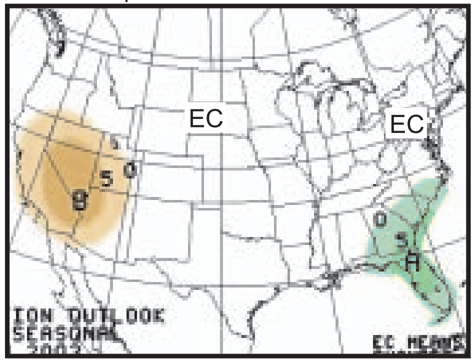
12. Precipitation: Multi-season Outlooks ♦ Source: NOAA Climate Prediction Center

Overlapping 3-month long-lead precipitation forcasts (released 06/19/03).

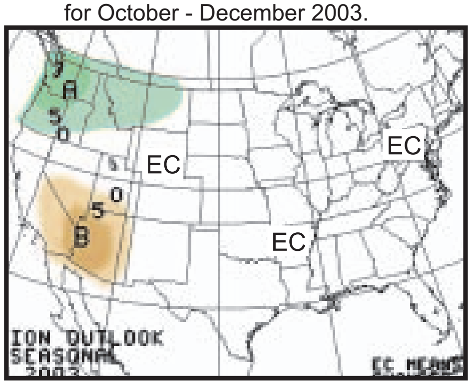
12a. Long-lead U.S. precipitation forecast for August - October 2003.



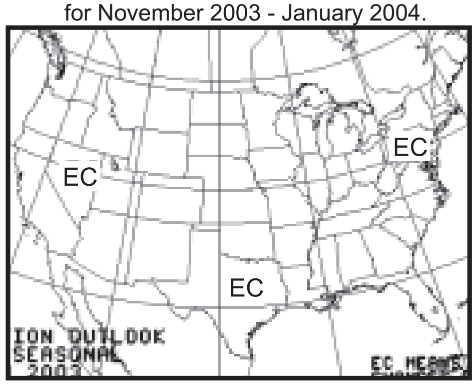
12b. Long-lead U.S. precipitation forecast for September - November 2003.



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



12d. Long-lead U.S. precipitation forecast for November 2003 - January 2004.



Percent Likelihood of Above or Below Average Precipitation*

5% - 10%	A = Above	
0% - 5%		
0% - 5%	B = Below	
5% - 10%		

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

Highlights: NOAA-CPC forecasters have withheld judgment with regards to precipitation forecasts for the summer (Figure 12a) and early winter (Figure 12d) in the Southwest. Figures 12b and 12c show small increases in the probability of below-average precipitation in parts of Arizona during the fall, based on a key forecast tool for the Southwest—trend-adjusted La Niña (see page 17) averages. The August through December IRI precipitation forecasts (*not pictured)* also withhold judgment for most of this period, although the IRI does indicate enhanced probabilities for below-average precipitation for parts of Mexico and the southwestern United States during the fall.

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.

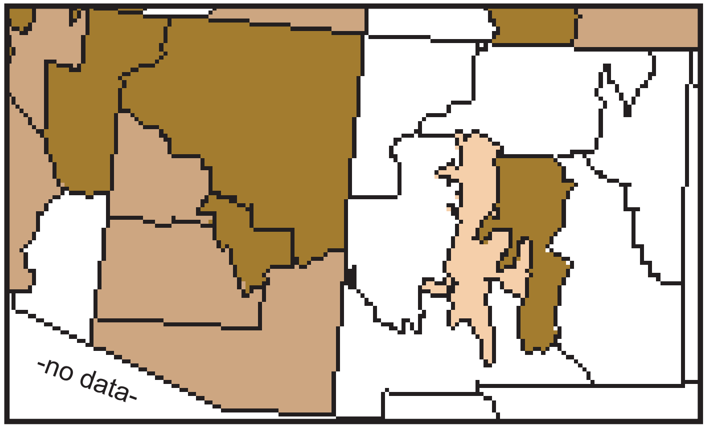
Thus, using the NOAA CPC excess likelihood forecast, in areas with light green shading (0-5% excess likelihood of above-average) there is a 33.3-38.3% chance of above-average, a 33.3% chance of average, and a 28.3-33.3% chance of below-average precipitation.

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 06/21/03 (accessed 06/19).



- -4.0 to -4.9 (extreme drought)
- -3.0 to -3.9 (severe drought)
- -2.0 to -2.9 (moderate drought)
- -1.9 to +1.9 (near normal)

13b. Seasonal drought outlook through September 2003 (accessed 06/19).

- Drought to persist or intensify
- Drought ongoing, some improvement
- Drought likely to improve; impacts ease

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.

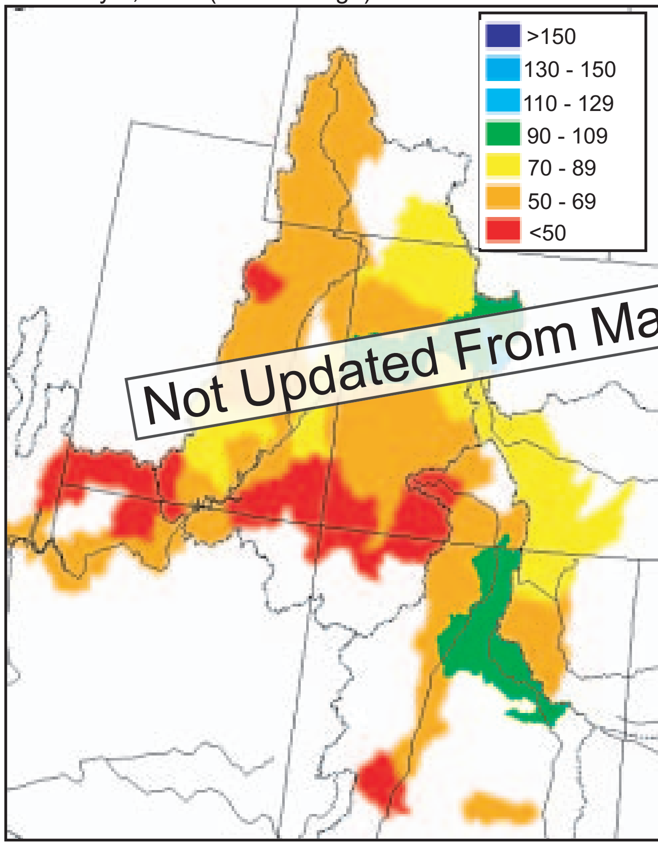
The delineated areas in the Seasonal Drought Outlook are defined subjectively and are based on expert assessment of numerous indicators including outputs of short- and long-term forecast models.

Highlights: The short-term Palmer Drought Severity Index (PDSI) forecast (Figure 13a) indicates near-average conditions across most of New Mexico. Drought conditions are expected to increase across most of Arizona, with extreme drought forecast for northern Arizona. The NOAA Climate Prediction Center (CPC) expects that there will be limited improvement in drought conditions in most of Arizona and New Mexico through September 2003. However, long-term drought conditions are likely to persist in the Southwest, as the benefits of snowmelt runoff and summer precipitation are likely to be overwhelmed by above-average temperatures and evaporation as well as long-term soil moisture deficits.

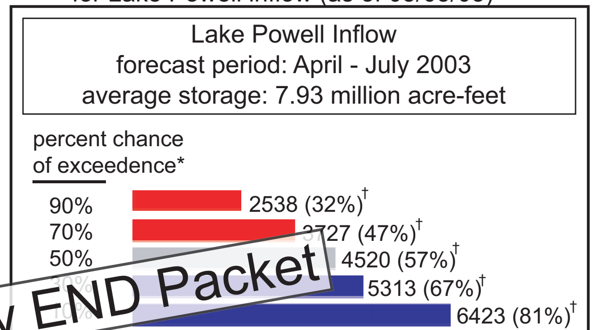
For more information, visit: http://www.drought.noaa.gov/

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

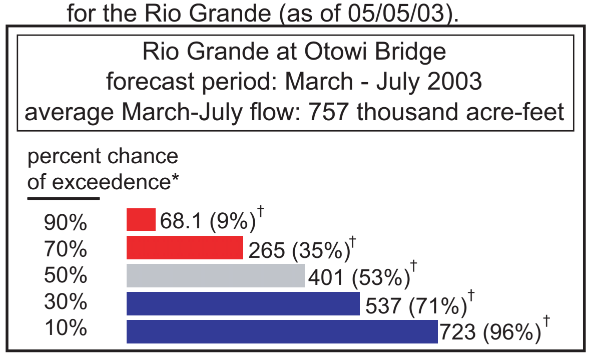
14a. NRCS spring and summer streamflow forecast as of May 1, 2003 (% of average).



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: The NRCS streamflow forecasts for spring and summer will not be updated again until January of 2004. Figures 14a-c have not been updated from the May END InSight packet. Please check with the websites listed below next year for updates.

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.

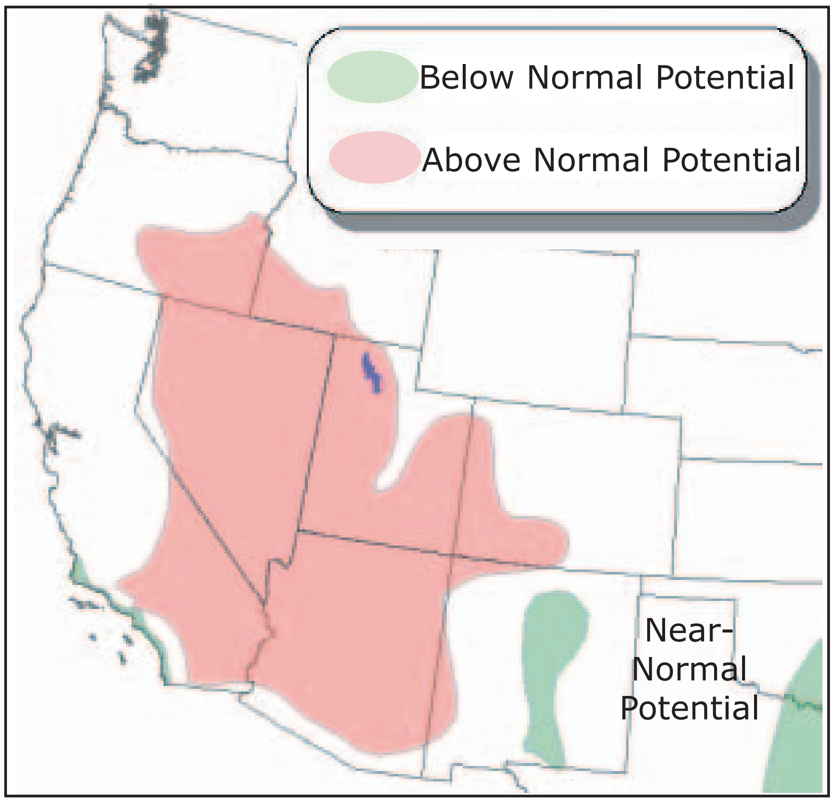
Each month, five streamflow volume forecasts are made by the NRCS for several river basins in the United States. These five forecasts correspond to standard *exceedence* percentages, which can be used as approximations for varying 'risk' thresholds when planning for short-term future water availability.

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.

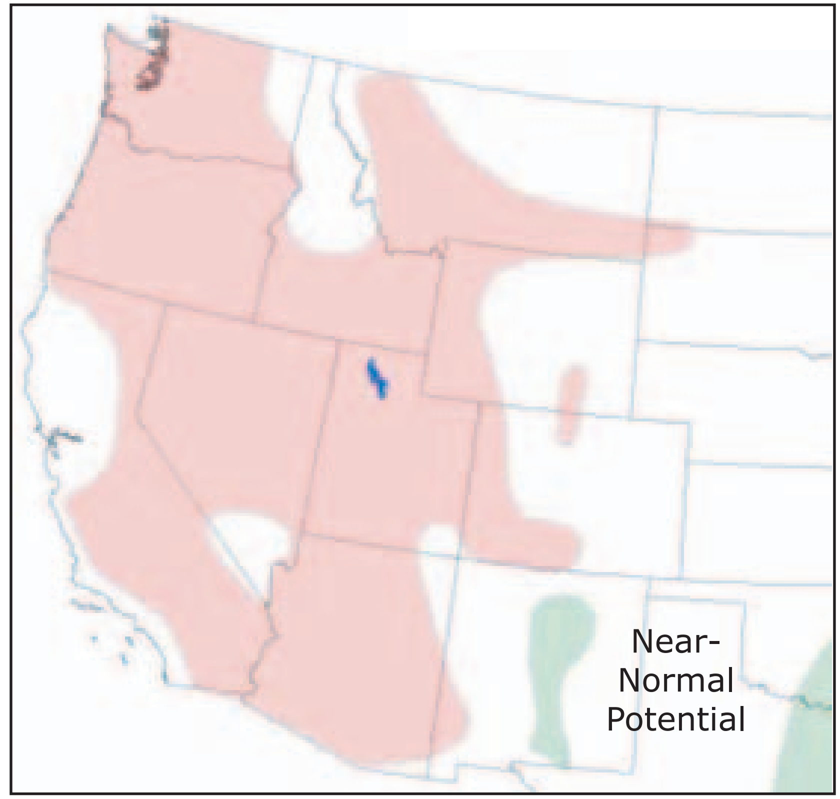
In addition to monthly graphical forecasts for individual points along rivers (Figures 14b and 14c), the NRCS provides a forecast map (Figure 14a) of basin-wide streamflow volume averages based on the forecasted 50% exceedence percentage threshold.

15. National Wildland Fire Outlook (Monthly and Seasonal) ♦ Source: National Interagency Fire Center

Monthly Wildfire Outlook (valid June 1 - June 30)



Seasonal Wildfire Outlook (valid June 15 - September 30)

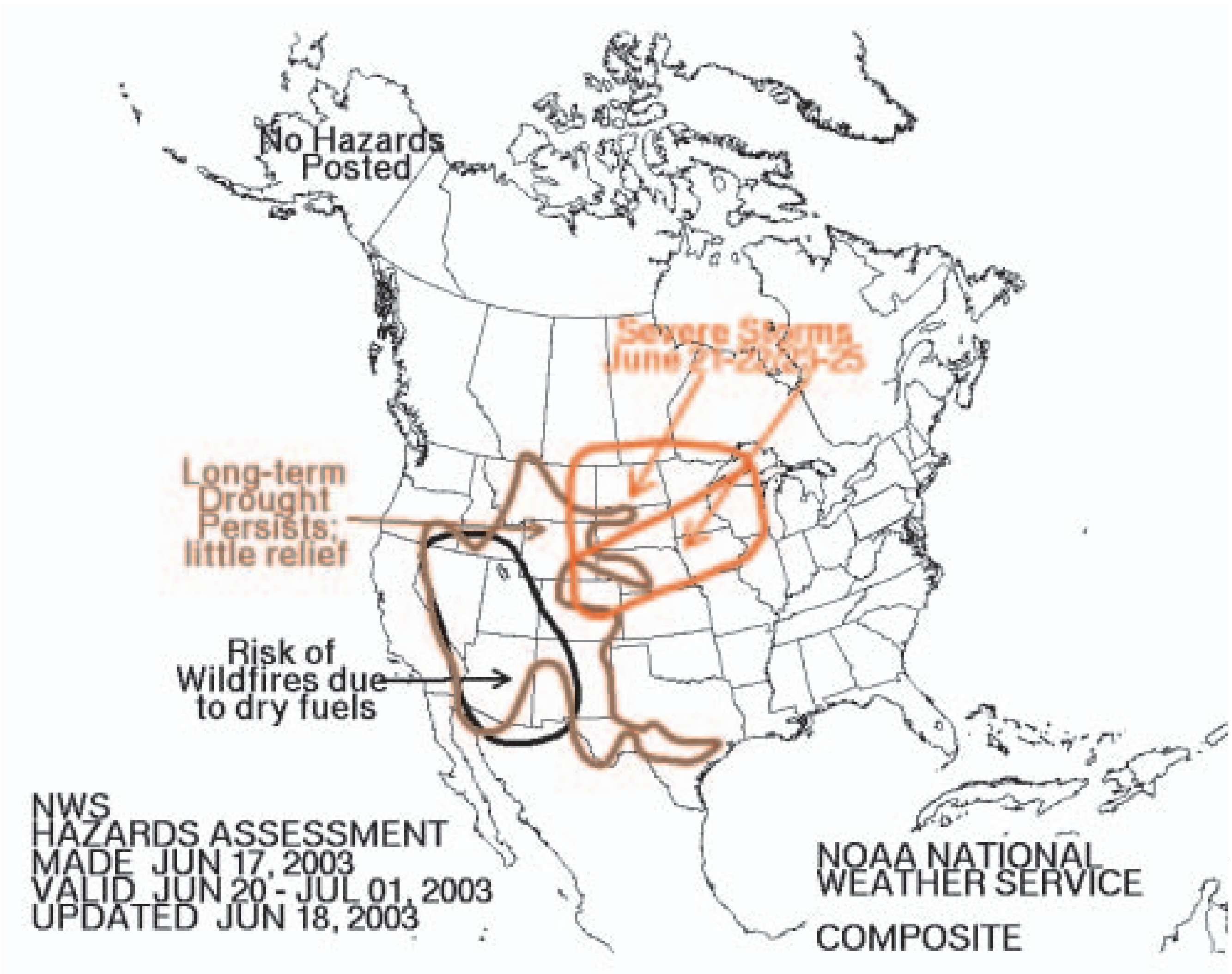


Notes: The National Interagency Coordination Center (NICC) at the National Interagency Fire Center (NIFC) produces monthly wildland fire outlooks (Figure 15). These forecasts consider climate forecasts and surface-fuels conditions to assess fire potential. They are subjective assessments, based on synthesis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

Highlights: As of June 19, 2003, 9,862 acres are burning in Arizona and 24,361 in New Mexico (this also includes a 20,000 acre complex of fires that is being managed to benefit resources). Overall, the 2003 fire season is significantly below average to date. Nationwide, by the end of June fire activity is projected to be at 70% of historic levels in terms of the number of fires and acres burned. However, much of the West is expected to experience above average fire conditions this season due to the prolonged drought and its impacts on vegetation and an abundance of dried grass and other fuels. Arizona, in particular, is at high risk for wildland fires, whereas almost all of New Mexico is projected to be at average to below average fire danger this season. According to the Southwest Coordination Center, above-average large fire (>100 acres) potential and resource use are expected, especially at elevations below 8,500 feet. Fire danger will remain at high levels until summer monsoon precipitation arrives. The Southwest area is currently at Preparedness Level IV, with the potential for fire activity to place large demands on Southwest Area and National 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 June 20 – July 1, 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

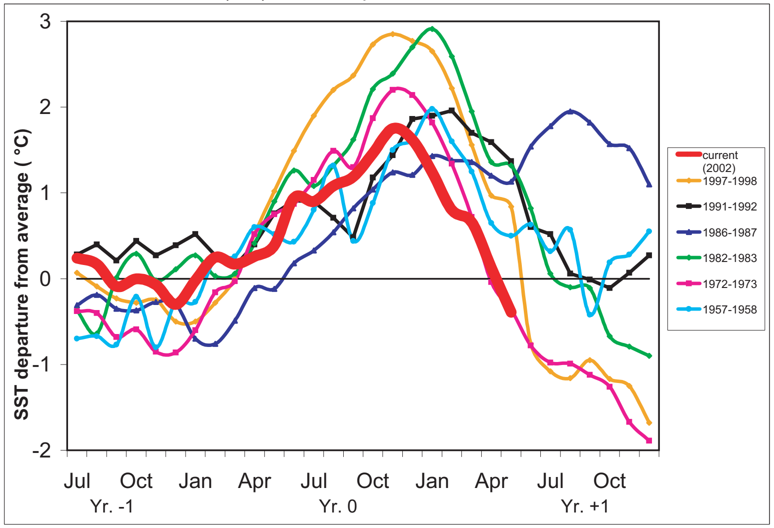
Soil and/or Fire:
http://www.cpc.ncep.noaa.gov/products/predictions/threats/s_threats.gif

Highlights: The U.S. Hazards Assessment forecasts the effects of long-term drought to persist at least through the end of June for much of Arizona and northern New Mexico. In addition, a protracted period of warm, dry conditions has increased wildfire risk throughout Arizona and western New Mexico. In particular, large fuel (so-called “1000-hour fuels,” i.e., dead and downed trees) moisture is at particularly low levels across southern and western Arizona and the “boot-heel” of southwestern 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

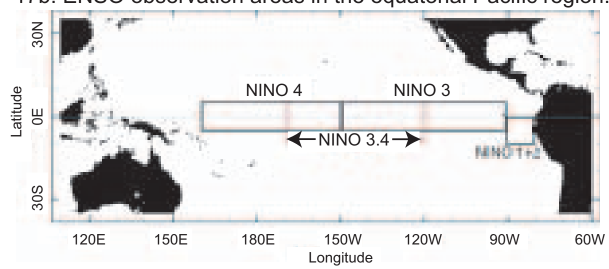
17a. Past and current (red) El Niño episodes.



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.

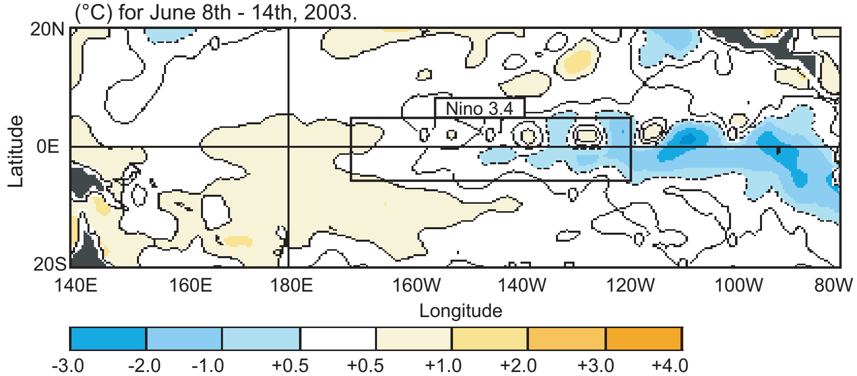
Each line on the graph represents SST departures for previous El Niño events, beginning with the year before the event began (Yr. –1), continuing through the event year (Yr. 0), and into the decay of the event during the subsequent year (Yr. +1).

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

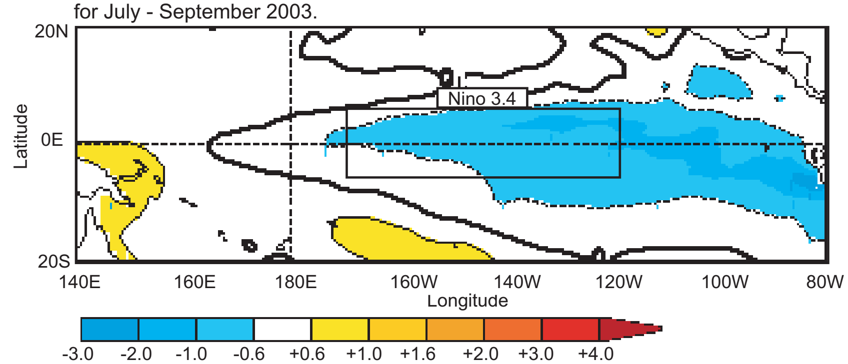


This year's SST departures are plotted as a red line (Figure 17a). The magnitude of the SST departure, its timing during the seasonal cycle, and its exact location in the equatorial Pacific Ocean are some of the factors that determine the degree of impacts experienced in the Southwest.

17c. 7-day averaged South Pacific sea surface temperature anomalies (°C) for June 8th - 14th, 2003.



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



Highlights: Eastern equatorial Pacific Ocean sea-surface (SST) and subsurface temperatures have continued to decrease in May and are now at below average levels (Figure 17c). Both oceanic and atmospheric conditions in the tropical Pacific are consistent with a developing La Niña episode, although forecasts are mixed about whether the La Niña will persist through next year or whether neutral or close to neutral conditions will develop. Forecast skill is low at this time of year. The International Research Institute for Climate Prediction (IRI) estimates that there is a 45% likelihood that La Niña conditions will develop in the next few months, and NOAA's Climate Prediction Center (CPC) concurs. Based on historical climate records, La Niña brings warm temperatures, reliably dry winters, and *sometimes* early monsoons with greater summer precipitation to the Southwest. La Niña episodes also influence the eastern tropical Pacific hurricane system, lowering tropical storm activity (and, as a result, the chances of late summer and fall tropical moisture making its way into the Southwest from the Pacific).

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

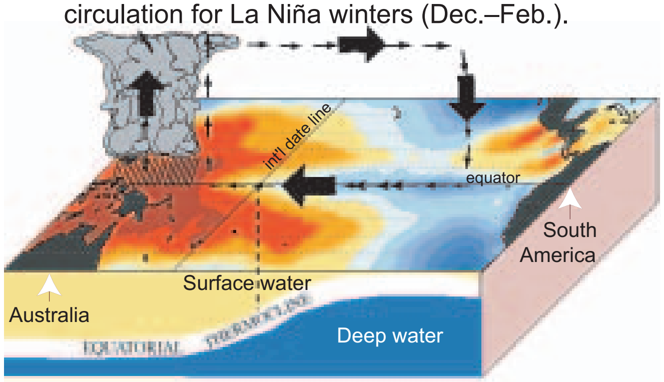
For more information about El Niño and to access the graphics found on this page, visit: http://iri.columbia.edu/climate/ENSO/

Section D

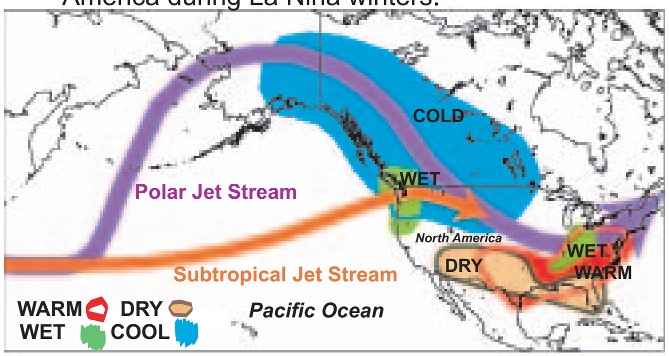
FOCUS ON LA NIÑA, THE MONSOON, AND EXPERIMENTAL PRODUCTS

18. La Niña ♦ Source: Climate Prediction Center, IRI, Desert Research Institute

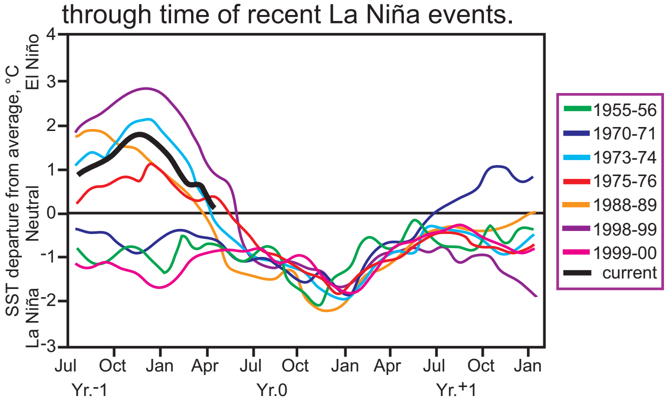
18a. Typical Pacific Ocean conditions and atmospheric circulation for La Niña winters (Dec.–Feb.).



18b. Typical atmospheric teleconnections to North America during La Niña winters.



18c. The sea surface temperature (SST) evolution through time of recent La Niña events.



Notes:

In Figure 18a, anomalously cool water (shown in blue) is present in the central and eastern Pacific Ocean and warm surface water (shown in red) and associated convection (shown by the thunder clouds and rising arrow) are restricted to the far western Pacific Ocean. These typical La Niña patterns influence the large-scale atmospheric circulation in the Northern Hemisphere (Figure 18b), including the position and strength of the jet stream. Figure 18b illustrates the relationship (or *teleconnection*) between atmospheric and oceanic conditions in the Pacific Ocean and climate conditions in North America. The persistent cooling in the central and eastern equatorial Pacific Ocean that occurs during a La Niña event contributes to an enhanced polar jet stream. The southern tier of the United States typically receives fewer storms than during non-La Niña winters and overall lower winter precipitation.

Figure 18c shows the development of recent La Niña events from the year before they occurred through the next two years. Several recent La Niña events were preceded by El Niño events (1973-74, 1975-76, 1988-89, and 1998-1999), as appears to be the case this year.

Highlights:

Forecasts for the remainder of 2003 indicate that La Niña conditions may develop in the equatorial Pacific (see page 17), altering large-scale circulation patterns (Figure 18a). Similar to El Niño events, La Niña events and their impacts typically are strongest in the Northern Hemisphere winter. La Niña winters are *consistently* drier than average in the Southwest, with the polar jet stream enhanced and diverted north of our region. Winter storms are steered into the Northwest (Figure 18b). La Niña winters are more consistently dry in Arizona than in New Mexico.

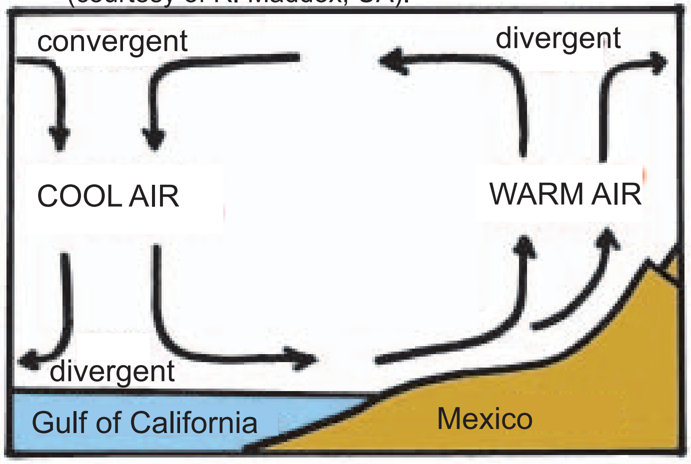
La Niña events occur every 2 to 7 years and may last for 1 to 3 years. As shown in Figure 18c, it is not uncommon for El Niño events to be followed immediately by La Niña events, without a "neutral" period in between (Figure 18c).This switch typically begins in the late spring or early summer. It is partly because of this tendency and partly because of the rapid decrease in equatorial Pacific SSTs (Figure 18c) that forecasts show high probabilities of La Niña conditions developing soon.

Neither La Niña nor El Niño conditions seem to play a large, direct role in summertime precipitation in the Southwest. In the sense that ENSO impacts winter precipitation in the Southwest, it indirectly also plays a role in monsoon rainfall patterns. Wet monsoons often follow dry winters in the Southwest, and wet winters often precede dry monsoons. For more information about the monsoon system, see page 19.

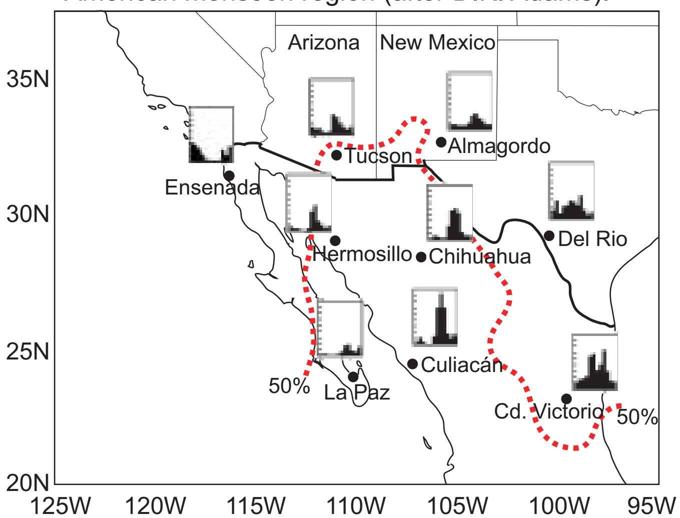
Figures 18a-b are modified from the CPC and Figure 18c is modified from IRI. For more information, visit: http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/lanina/
http://iri.columbia.edu/climate/ENSO/currentinfo/QuickLook.html

19. The North American Monsoon ♦ Source: USGS, NWS, CLIMAS

19a. Thermally driven monsoon air circulation regime (courtesy of R. Maddox, UA).



19b. Seasonality of precipitation by month for the North American monsoon region (after D.K. Adams).



Highlights:

Figure 19a shows atmospheric conditions that relate to the North American Monsoon. The monsoon is driven by unequal heating (or cooling) of the ocean and land. Low pressure over the land, which develops as the land heats up in the summer, causes moisture-laden air to move into northwestern Mexico and the Southwest. This is influenced by low-level circulation patterns that supply moisture from the tropics via the Gulf of California and from the Gulf of Mexico. The result is the summer monsoon rains.

Monsoon precipitation in North America results not only from the thermally driven air circulation depicted in Figure 19a but also from complex interactions between atmospheric circulation and the extremely varied topography present in the region. Monsoon thunderstorm activity is difficult to model and forecast as a result of these complicated relationships. The preliminary 2003 monsoon forecast by State Climatologist for Arizona, Andrew Ellis, is for a weak early monsoon (mid-June through mid-July), with less-than-average precipitation levels in Arizona and New Mexico, and a moderate to weak middle monsoon (mid-July through early September), with close-to-average precipitation levels.

In the North American Monsoon region, 10-30 percent or more of the annual rainfall occurs in July, the month the monsoon usually begins in the United States (Figure 19b). In U.S. monsoon areas, it is often preceded by a dry period in May and June. The red line in Figure 19b separates the core monsoon region (to the south) that receives at least 50% of annual precipitation in July, August, and September from more peripheral monsoon regions to the north. Arizona and New Mexico lie climatologically on the fringes of the North American Monsoon.

As a result, summer precipitation is much more variable and its distribution becomes even more influenced by the topography of the Southwest—higher elevations receive a much greater occurrence of thunderstorm activity and precipitation. Much of the intraseasonal variability in precipitation in the Southwest may be related to the penetration of moisture-laden air originating as far south as the mouth of the Gulf of California. As the moist air crosses the elevated regions of the deserts of Sonora and Arizona, convective activity increases, resulting in widespread precipitation events.

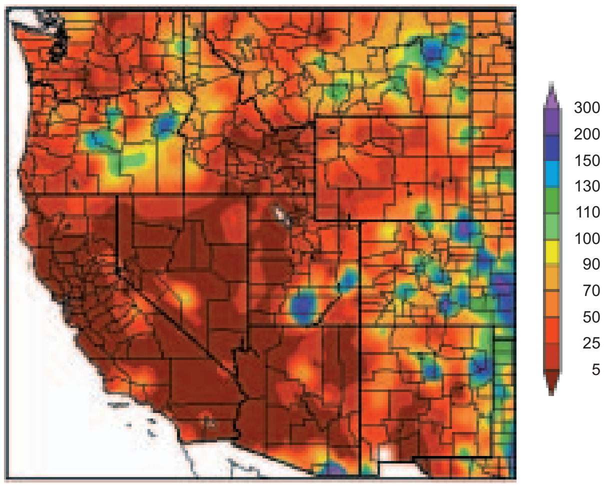
Although concurrent ENSO conditions do not directly affect summer monsoon precipitation, research indicates an indirect ENSO connection. El Niño winters tend to be wetter than average in both northwestern Mexico and the Southwest; wet winters tend to be followed by drier than average summer monsoons. The opposite pattern emerges after a dry winter (and La Niña winters are consistently drier than average).

Interestingly, the timing of the start of the monsoon season in the Southwest is related to the intensity of the monsoon, such that early-onset monsoons are often very wet and late-onset monsoons, very dry. In addition, monsoon rainfall in the Southwest is out of phase with summer rainfall in the Midwest—wet Southwest monsoons are associated with dry midwestern summers and vice versa.

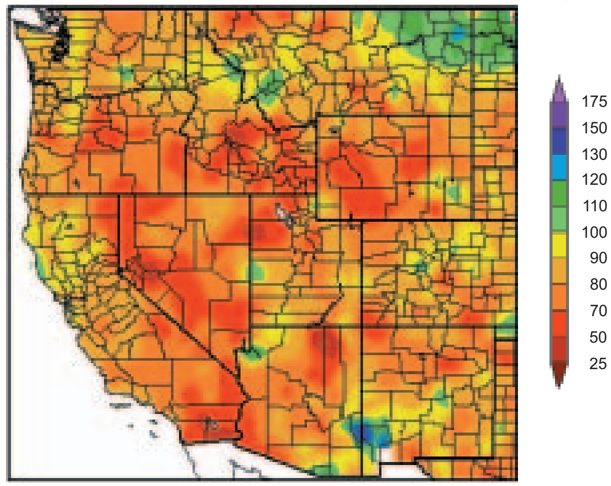
For more informtion, visit: http://www.wrh.noaa.gov/Tucson/monsoon/monsoon.html; http://www.phx.noaa.gov/general/monsoon/; http://geochange.er.usgs.gov/sw/changes/natural/monsoon/

20. Experimental ACIS Maps Source: High Plains Regional Climate Center (HPRCC)

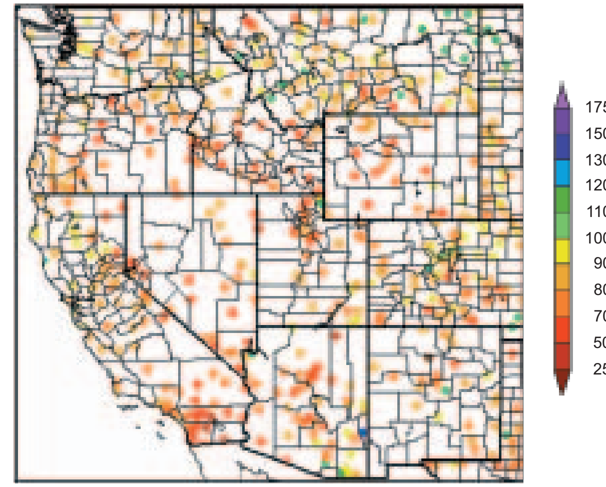
20a. Percent of average precipitation in the West over the past month (5/11/03 – 6/9/03).



20b. Percent of average precipitation in the West over the past 36 months (6/10/00 – 6/9/03).



20c. Percent of average precipitation in the West over the past 36 months (6/10/00 – 6/9/03).



Notes:

The High Plains Regional Climate Center (HPRCC), located at the University of Nebraska in Lincoln, partnering with the National Climatic Data Center, Regional Climate Centers, and State Climate Offices, has developed ACIS (Applied Climate Information System), web-based software for the summarization and dissemination of important climate-related information. This includes precipitation, temperature, and cooling and heating days.

Figures 20a-c show one of the ACIS products (percent average precipitation for the West) at two different time scales (for the previous month and for the past 36 months). Other precipitation products include total precipitation and departure from average; other time scales include previous 1, 7, 30, 60, and 90 days and 12, 24, and 36 months. Figure 20c is the same as Figure 20b, but is a dot map, which allows the user to see the distribution of stations used to create the shaded maps. Note that the legend bars for percent of average precipitation are not equivalent for the two figures. County lines on ACIS maps help users to more easily locate themselves than they are able to with the recent temperature and precipitation maps (pages 1 and 2) that we currently use.

Highlights:

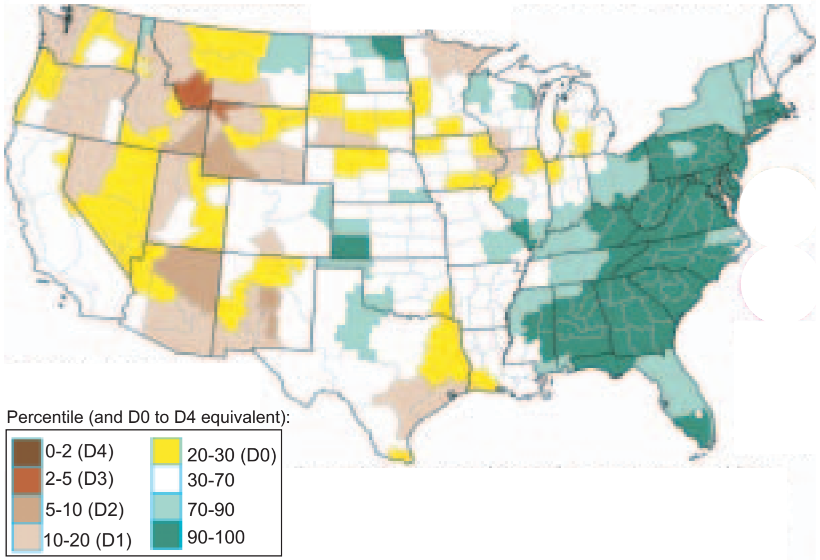
Figures 20a-b highlight the persistent nature of drought in the West, with overall precipitation at about 70 percent of average over the past three years. In the short term (Figure 20a), precipitation over most of the Southwest (California, Nevada, Arizona, and New Mexico) has been at levels way below average.

It is important to understand the seasonal context when examining these figures. For example, May typically is one of the driest months of the year in the Southwest (part of the very arid foresummer that precedes the monsoons). Even a small decrease in the amount of precipitation received at a particular station in May may lead to a very large change in the percent of average precipitation shown in Figure 20a (e.g., receiving 0.5 inches less rain in May, when the average total precipitation might only be 1 inch, leads to a designation of 50 percent of average; receiving 0.50 inches less rain in February, when the average total precipitation might be 4 inches, leads to a designation of 88 percent of average).

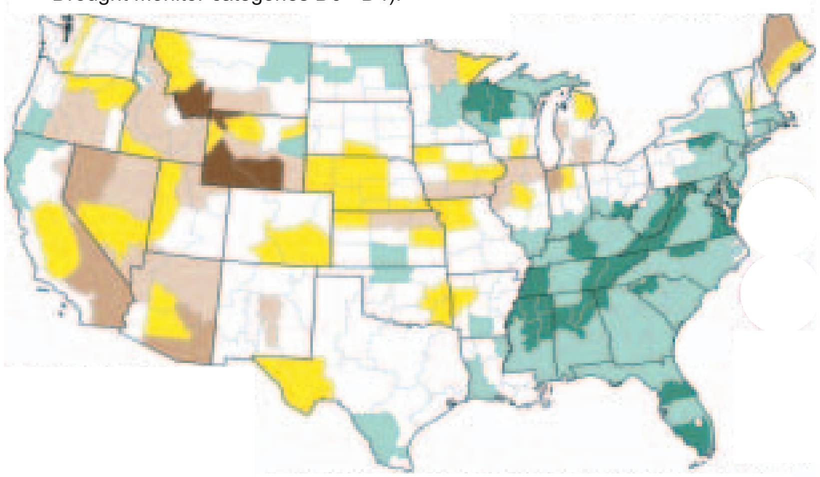
For more information, visit: http://www.hprcc.unl.edu/products/current.html

21. Experimental Drought Blend Maps ♦ NOAA Climate Prediction Center

21a. Map of short-term drought indicator blend percentiles (and equivalent Drought Monitor categories D0 - D4).



21b. Map of long-term drought indicator blend percentiles (and equivalent Drought Monitor categories D0 - D4).



Notes: The NOAA Climate Prediction Center has developed two new experimental climate products depicting drought status on different time scales (Figures 21a and 21b). These products will serve as timescale-specific supplements to the U.S. Drought Monitor (see Page 3 of this packet). Both products assess conditions based on a weighted combination (i.e, 'blend') of several drought indicators. Data are provided by the National Weather Service, National Climatic Data Center, and NOAA Climate Prediction Center.

The Short-Term Blend (Figure 21a) approximates drought-related impacts that respond to precipitation (and secondarily other factors) on time scales ranging from a few days to a few months. This is useful for assessing wildfire danger, non-irrigated agriculture, topsoil moisture, range and pasture conditions, and unregulated stream flows.The indices used (and their relative weights) are as follows: Palmer Z-Index (35%), 3-month precipitation (25%), 1-month precipitation (20%), CPC soil moisture model (13%), and (modified) Palmer drought index (7%).

The Long-Term Blend (Figure 21b) approximates drought-related impacts that respond to precipitation on time scales ranging from several months to a few years. Thisis useful for assessing impacts on reservoir stores, irrigated agriculture, groundwater levels, and well water depth. The indices used (and their relative weights) are as follows: Palmer Hydrologic Drought Index (25%), 12-month precipitation (20%), 24-month precipitation (20%), 6-month precipitation (15%), 60-month precipitation (10%), and CPC soil moisture model (10%).

Figures 21a and 21b represent short- and long-term drought conditions as percentiles of the long-term record (1932-2000) of the blended indices used for each product. For example, on the figures, areas with the color indicating the percentile category '0-2 (D4)' are experiencing drought conditions more intense than 98 percent of the historical distribution of drought conditions (for that area) based on the blended (and weighted) indices.

Highlights: These products are still considered experimental and are subject to change. It is expected that the representation of drought conditions in particular areas is somewhat sensitive to the indices (and weights of indices) chosen to produce the short- and long-term blended percentiles. Users can provide feedback to the developers of the drought blend maps by visiting the website listed below and filling out a short online form.

Figures 21a and 21b capture the effects of the recent wet spell on the East Coast and also both the short-term and long-term dryness in the West.

To access the most up to date drought blend maps and more detailed information on the development of these maps, visit: http://www.cpc.ncep.noaa.gov/products/predictions/experimental/edb/droughtblend-access-page.html