

INTERMOUNTAIN WEST CLIMATE SUMMARY



by The Western Water Assessment

Issued April 21, 2006

April 2006 Climate Summary

Hydrological Conditions – Most of the Intermountain West region is not in drought conditions or is in low stages of drought. Areas in drought are expected to persist in drought through at least July, including eastern Colorado and parts of Wyoming. Some areas with high snow pack now have spring flood risks.

Temperature – Temperatures for the month of March were around average for the region, which is cooler than it was last year in 2005.

Precipitation/Snowpack – Precipitation totals were highest in Utah and western Colorado, where they exceeded 200% of average. The rest of the region had average to below average precipitation totals in March.

ENSO - La Niña conditions have weakened rapidly and ENSO-neutral conditions prevail; ENSO is not a significant factor in U.S. climate for the summer.

Climate Forecasts - Outlooks project above average temperatures for the Intermountain West region through August, and Colorado and Utah are at risk for below average precipitation over the May-July period.

SPRING FLOOD RISK AND FIRE ASSESSMENT

Two other climate-influenced natural hazards are hot topics this month: floods and fire. Some areas with high snowpack, especially in Utah, are at increased risk for spring floods. You can track flood risks at <http://www.hpc.ncep.noaa.gov/national-floodoutlook> and at <http://www.weather.gov> which has links to your local NWS office forecasts. Fire risk was the topic at the National Seasonal Assessment

Workshops for the Western States and Alaska in hosted by NOAA in Boulder in early April. These workshops are sponsored by agencies including the National Interagency Coordination Center, the Desert Research Insti-

tute, and Climate Assessment for the Southwest (CLIMAS). Climatologists and fire managers convene to produce seasonal fire outlooks based on critical factors for fire risk including carry-over herbaceous fuels, drought status,

and climate outlooks. Above average fire potential is expected in the drought-stricken southern Rockies and central Plains. Due to above-average snowpack, the fire potential in the northern Colo-



rado Rockies is forecast to be below normal, especially higher elevation timbered areas. The assessment will be available at: <http://www.ispe.arizona.edu/climas/conferences/NSAW/publications.html>.

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On the Web: <http://wwa.colorado.edu>

Contact Us - Send questions or feedback, or to sign up for our summary e-mail announcement, please e-mail us at: WWASummary@wwa.colorado.edu.

Brad Udall – WWA Director
Andrea Ray – Editor/writer
Jessica Lowrey – Assistant Editor/writer
Eileen McKim - Assistant Editor/writer
Barb DeLuisi - Graphic Designer

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South Platte Regional Assessment Tool (SPRAT)

By Chris Goemans, Western Water Assessment

This article describes the development of a regional water resource model capable of modeling the impacts of future population growth and increased climatic variability on water users throughout the South Platte River Basin.

Why Develop a Model of the South Platte?

Located in the northeastern corner of Colorado, the South Platte River basin (South Platte) is unique in that it serves both the most populous section of the State and includes the nation's third largest irrigation system. Between 1950 and 2000, population in the South Platte basin nearly tripled, increasing at an average annual rate of 2.7 percent per year. As of 2000, total population within the basin exceeded 2.9 million people. This growth is expected to continue with total population projected to more than double by 2050. Population growth, combined with the recent drought, has highlighted the need for a better understanding of how future changes to the South Platte will affect water management within the region and for exploring the potential benefits and interactions of various management options designed to reduce vulnerability to shortages.

Several large water providers throughout the Basin have developed sophisticated models specific to their management areas, however, a regional model of the South Platte capable of analyzing the effects of continued growth, and/or increased climatic variability, on water users throughout the Basin does not currently exist. This shortcoming is not unique to the South Platte. Throughout the Southwest, it is common for water supply projects to be evaluated from only a local perspective without consideration for the long-term impacts to other areas, users, and proposed developments within the basin (Dai and Labadie, 2001). Planning efforts utilizing a narrowly focused "safe yield" process focus often ignore these other considerations and interactions when calculating the physical ability of a particular project to meet specific forecasted demands under a drought of record. This shortcoming was illustrated during Colorado's recent Statewide Water Supply Initiative (SWSI), which reviewed dozens of individual water plans to assess future water supply conditions on the regional scale, concluding:

During the SWSI process, it became apparent that many water providers had identified the same sources of water and there may not be adequate supplies to meet the needs of the various providers. (Colorado Water Conservation Board, 2004: 6-3).

South Platte Regional Assessment Tool

The South Platte Regional Assessment Tool (SPRAT) was developed by the Western Water Assessment to address regional water supply vulnerabilities in a coordinated way. SPRAT models the allocation of water throughout the South Platte basin with respect to current physical, institutional, and environmental constraints, as well as under future scenarios that include population change, climatic variability, and changes to infrastructure. In addition to assessing vulnerabilities, the model provides a mechanism for exploring the potential benefits of various management options designed to reduce vulnerability. For example, SPRAT can be used to obtain a better understanding of how future droughts of various lengths may affect water supplies and demand throughout the system, and can then assess the value of various coping strategies for mitigating the expected impacts. This assessment is not done at the scale of individual water

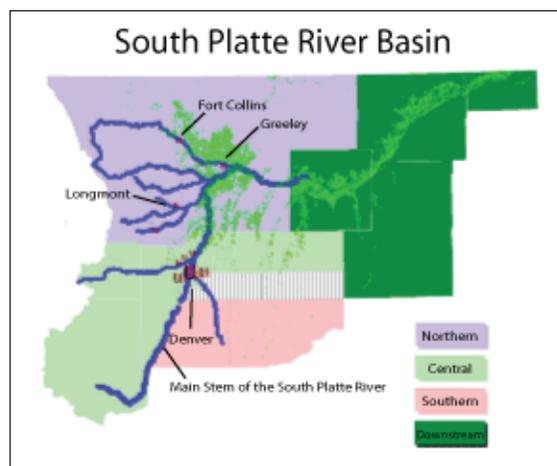


Figure 1a: Map of the South Platte River Basin, showing the four regional divisions used in the SPRAT model.

systems, but rather at the scale of four South Platte sub-regions (Northern, Central, Southern, and Downstream). This is shown in Figure 1a.¹

Water routed through SPRAT derives from historical and recreated inflows and climatic conditions at 28 points throughout

¹ Each sub-region was identified based on its water demand and supply characteristics relative to the rest of the South Platte. The Southern Region includes the rapidly growing and groundwater dependent "south Metro" area; the Central Region includes most of the Denver-Aurora region and water systems reliant on South Platte, Colorado, and Arkansas River surface water supplies; the Northern Region is primarily defined by those agricultural and rapidly expanding municipal areas served by the Colorado-Big Thompson Project; while the Downstream region includes sparsely populated agricultural areas extending to the state line.



the basin spanning 80 years. Supplies consist of five sources: (1) climate-driven runoff (inflows and gains), (2) imported water from adjacent basins (including both the Arkansas and Colorado River basins), (3) return flows, (4) aquifers (not reflected in Figure 2), and (5) reservoir carryover from previous years. The

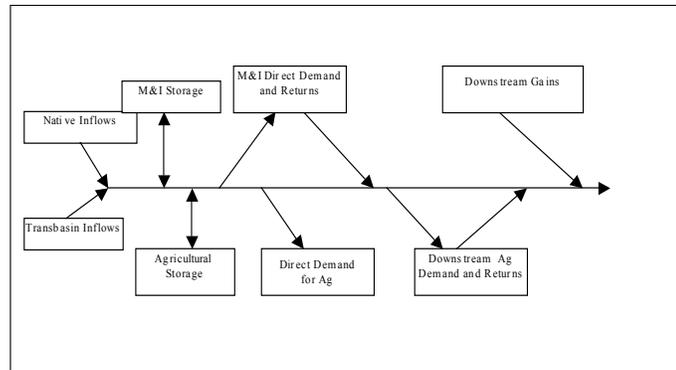


Figure 1b: A simplified illustration of the layout of the SPRAT model over a single stretch of river, within a single region, including the different types of water and water-users accounted for in SPRAT.

management, timing, location, and reliability of each are unique to each sub-region within the Basin and play significant roles in determining each supply’s ability to satisfy potential demand. For example water users in the Northern sub-region have access to highly reliable flows available via the federal Colorado Big-Thompson project, whereas users in the Southern sub-region rely predominantly on groundwater from the Denver Basin Aquifer.

SPRAT allocates available supplies to existing demands during each month over the 80 year climate record, consistent with current institutional and legal constraints on water allocation (i.e. prior appropriation). Demands are divided into two sectors: (1) municipal and industrial (M&I) and (2) agricultural (Ag). Municipal and industrial demands (M&I) exist in the Northern, Central and Southern regions; whereas agricultural demands exist in the Northern (both upstream and downstream of M&I demands), Central, and Downstream regions. Regional population totals and per capita use are used to generate “base” level M&I demands. Temperature and precipitation are used to adjust base M&I demands in each period. Ag demands are generated using irrigated acreage and climate adjusted per acre application rates.

Figure 1b presents a simplified illustration of the layout of the model over a single stretch of river, within a single region, including the different types of water and water-users accounted for in SPRAT.

Base demands and infrastructure remain constant throughout a given model run (i.e. series of inflow and climate inputs). Thus,

model output provides an estimate of what would happen under the *semi-static* demand and infrastructure conditions, given the dynamic series of climatic inputs in the model. The term semi-static is used because population levels are assumed constant in each model run, however per capita demands are adjusted to reflect variability in temperature and precipitation.

Output from SPRAT is available at every point in the model, during every month over the entire period simulated. This output includes streamflow levels, reservoir contents, diversion amounts and unmet demands. Moreover, the design of the model allows users to track the allocation and flow of each of the different types of water (e.g. return flows, trans-basin imports, etc.) included in the model. Thus, those interested in analyzing the impacts of increased diversions to M&I users on water quality, for example, can track the change in return flows relative to total flows throughout different regions in the model.

Example Model Results: The Impact of Increased M&I Demands on Irrigated Agriculture

It is commonly postulated that population growth has, and will, result in the loss of irrigated acreage. One recent report, for example, forecasts the loss of 3.1 million acres of agricultural land across Colorado by 2022 due to increased residential development.² Projections of this type are typically based on limited historical data, rather than on a systematic analysis that explicitly links M&I trends to agricultural water availability both spatially and temporally. In contrast, SPRAT allows planners the opportunity to directly model how increased deliveries to M&I users will impact supplies available for irrigated acreage by sub-region and with respect to varying types of climatic events, growth rates, and infrastructure expansions.

As an illustration, consider model runs comparing two scenarios based on historical climatic conditions from the period 1918 to 2002: *Baseline* (current population and infrastructure conditions) and *2030 Population* (projected 2030 population with no policy or infrastructure changes). Model estimates of annual, agricultural, *unmet demands* were prepared under each scenario. These two scenarios allow for the isolation of the effects of increased deliveries to M&I users on the flows available for agricultural users in each sub-region. Results are shown in Figure 1c, which provides predicted changes (*Baseline* to *2030 Population*) in unmet agricultural demands as a percent of total demand over the period of study. Positive (negative) values indicate an increase (decrease) in unmet demands.

Consistent with conventional wisdom, the model predicts increasing M&I demands in the Northern sub-region will reduce the

² *Losing Ground: Colorado’s Vanishing Agricultural Landscape* (Environment Colorado Research and Policy Center, 2006)



flows available for junior irrigators in that area resulting in an increase, on average, of unmet agricultural demands. However, somewhat surprisingly, unmet demands actually are shown to decrease in the Central and Downstream sub-regions. In these two areas irrigated agriculture is primarily located downstream of most M&I demands. Under the *2030 Population* scenario, water which was previously diverted to meet upstream, agricultural demand and excess groundwater pumping is now utilized to meet M&I demands, which results in increased return flows for downstream users in both sub-regions. On average, these return flows reduce unmet demands for irrigators in each of these two sub-regions.

Is this our prediction of the future? Not hardly. These scenarios are admittedly simplistic; for example, the *2030 Population* scenario used here does not account for many of the likely institutional and infrastructure changes that would accompany such growth (e.g., water transfers, reservoir development, etc.). Additional scenarios with varying levels of population growth, policy or infrastructure changes, and simulated climatic conditions could provide a much richer picture of possible future outcomes, helping communities to make more informed choices about vulnerabilities, sensitivities, and appropriate adaptations. SPRAT is designed to facilitate this thinking.

Future Research

SPRAT offers stakeholders throughout the South Platte Basin a new tool for exploring possible water futures in a way not possible through other means. Any party interested in exploring additional scenarios is encouraged to contact the Western Water Assessment for a SPRAT demonstration and/or to discuss a potential collaborative project.

Further information regarding SPRAT is available from Chris Goemans (chris.goemans@colorado.edu).

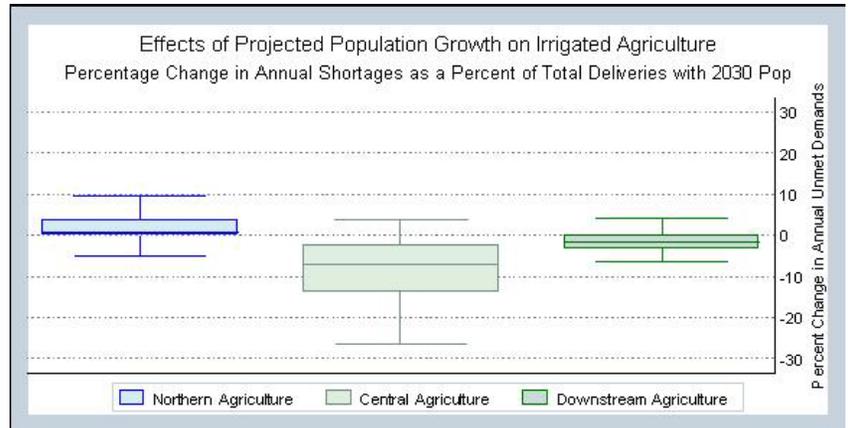


Figure 1c: Chart showing predicted changes for an example model run (Baseline to 2030 Population) in unmet agricultural demands as a percent of total demand over the period of study. Positive (negative) values indicate an increase (decrease) in unmet demands. The boundaries of each “box” identify the 25th and 75th percentiles of the change in unmet demands as a percentage of total agricultural demand in each region. The range between each of the “Whiskers” accounts for approximately 90% of the observed values for each region.

References:

Colorado Water Conservation Board, “Statewide Water Supply Initiative.” November 2004. <http://cwcb.state.co.us/SWSI/swsireport.htm>

Dai, T. and J. Labadie, “River Basin Network Model for Integrated Water Quantity/Quality Management,” *Journal of Water Resources Planning and Management*, ASCE, 127(5), pp. 295-305 (Sep/Oct 2001).

Environment Colorado Research and Policy Center, “Losing Ground: Colorado’s Vanishing Agricultural Landscape.” April 2006. <http://www.environmentcolorado.org/envco.asp?id2=23275>.

On the Web

- For more information about SPRAT, visit their website at: <http://wwa.colorado.edu/products/sprat>.



Temperature through 3/31/06

Source: High Plains Regional Climate Center

Temperatures for most of the Intermountain West region for March 2006 were near average (Figures 2a-b) ranging from 15°F to 30° F in western **Wyoming** and north central **Colorado** to 40° F - 50° F in southeastern **Utah**. Most of the Intermountain West region was within 2° above or below average for the month, with the exception of **Utah**, where the entire state was below average with some areas in the southwestern section of **Utah** cooler than average by 4° F to 6° F.

In comparison to March 2005 (Figure 2c) temperatures were, on average, lower in most areas in 2006. In **Colorado**, the temperature gradient in 2005 went from below average in the south to above average in the north, but that gradient was reversed in 2006. **Wyoming** was below average in March 2006 for all but the northeastern section in contrast to the 2005 above average temperatures across the state.

Notes

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

These maps are derived by taking measurements at individual meteorological stations and interpolating (estimating) values between known points to produce continuous categories. Interpolation procedures can cause aberrant values in data-sparse regions. For maps with individual station data, please see web sites listed below.

Figures 2a-c are experimental products from the High Plains Regional Climate Center. These data are considered experimental because they utilize the newest data available, which are not always quality controlled.

On the Web

- For the most recent versions these and maps of other climate variables including individual station data, visit: <http://www.hprcc.unl.edu/products/current.html>.
- For information on temperature and precipitation trends, visit: <http://www.cpc.ncep.noaa.gov/trndtext.htm>.
- For a list of weather stations in Colorado, Utah, and Wyoming, visit: <http://www.wrcc.dri.edu/summary>.

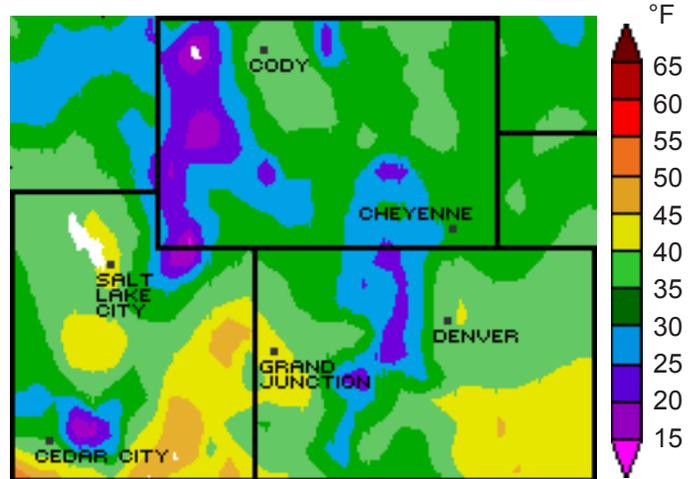


Figure 2a. Average temperature for the month of March 2006 in °F.

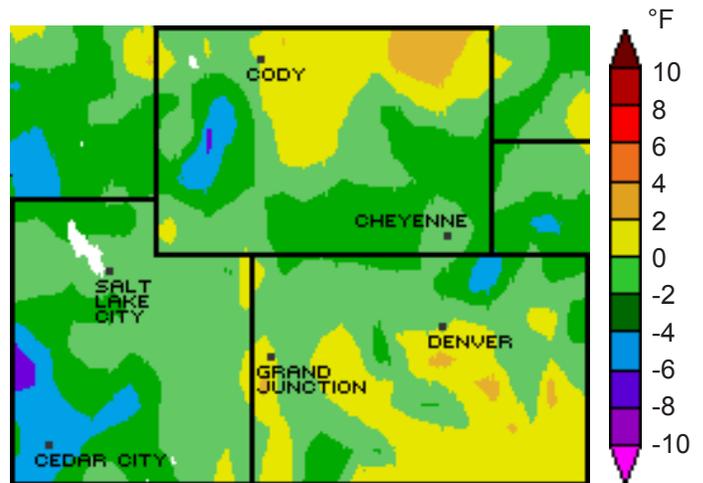


Figure 2b. Departure from average temperature for the month of March 2006 in °F.

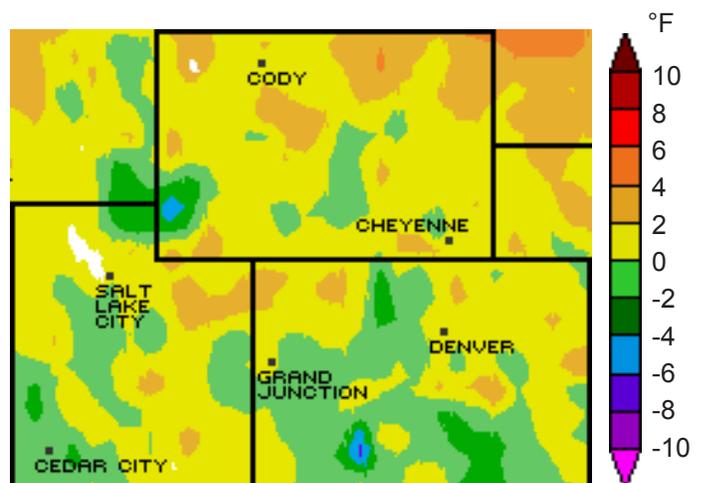


Figure 2c. Departure from average temperature in °F for last year, March 2005.



Precipitation through 3/31/06 Source: NOAA/ESRL/PSD Climate Diagnostics Branch, NOAA Climate Prediction Center

Precipitation in the Intermountain West regions falls primarily as snow in March, and snowpack and snow water equivalent (SWE) depend on elevation. On the plains, however, some precipitation falls as rain at this time of the year, depending on temperatures. In March 2006, precipitation totals for the tri-state area ranged from .25 to +3 inches and the region had greater percent of average precipitation than last month (Figure 3a-b). Southwest **Colorado** had above average precipitation (150% to over 200%) for the first time this year. On the other hand, portions of eastern **Colorado** on received 40% to 80% of average precipitation in March. **Wyoming's** March precipitation was mostly near average, with some areas in the northern half receiving 40% to 80% of average, and the southeast corner received 120% to over 200% of average. **Utah** received abundant moisture in March and the entire state had over 200% of average precipitation, much improved over totals for January and February 2006. According to the hydrologic outlook of Brian McInerney of the NWS Weather Forecast Office in Salt Lake City, this increase in moisture means an increased flood potential for northwestern **Utah**. See the Utah summary (page 12) for more information. Percent of average precipitation since the start of the water year 2006 (Figure 3c) shows that most of the Intermountain West region is about average with the exception of northwest **Utah**, southeast **Wyoming**, the north central mountains and northeastern plains of **Colorado** where precipitation amounts are at 120% to over 200% of average.

Notes

The water year runs from October 1 to September 30 of the following year. As of October 1, 2005, we are in the 2006 water year. The water year is more representative of climate and hydrological activity than the standard calendar year. It reflects the natural cycle of accumulation of snow in the winter and runoff and use of water in the spring and summer.

Average refers to the arithmetic mean of annual data from 1996-2005. This period of record is only ten years long because it includes SNOTEL data, which have a continuous record beginning in 1996. Percent of average precipitation is calculated by taking the ratio of current to average precipitation and multiplying by 100.

The data in Figs. 3a-c come from NOAA's Climate Prediction Center. The maps are created by NOAA's Climate Diagnostics Center, and are updated daily (see website below). These maps are derived by taking measurements at individual meteorological stations and interpolating (estimating) values between known data points to produce continuous categories.

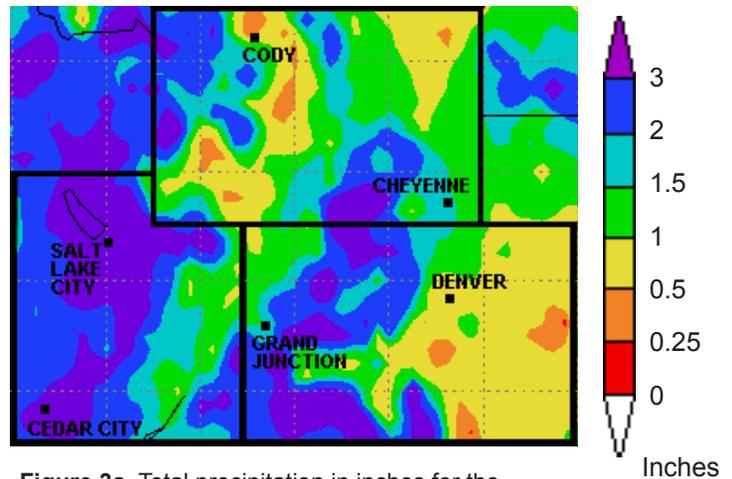


Figure 3a. Total precipitation in inches for the month of March 2006.

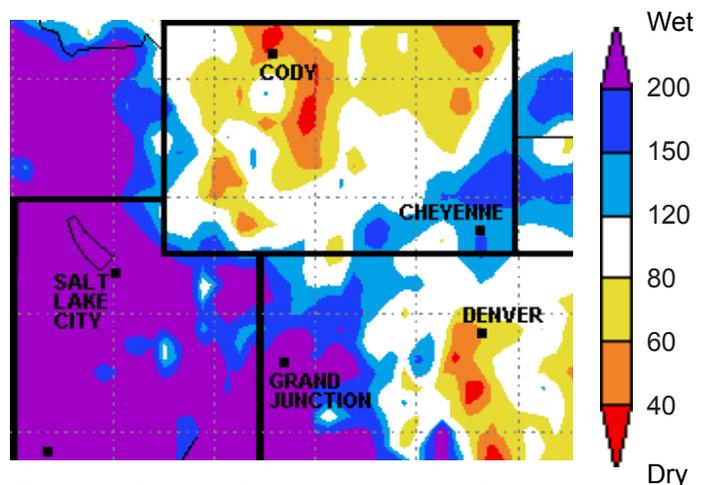


Figure 3b. Percent of average precipitation for the month of March 2006.

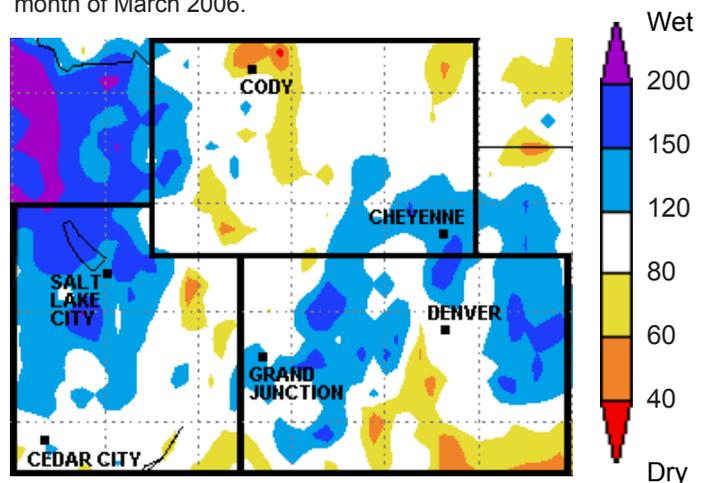


Figure 3c. Percent of average precipitation accumulated since the start of water year 2006. (Oct. 1 - Mar. 31, 2006).

On the Web

- For the most recent versions of these and maps of other climate variables including individual station data, visit: <http://www.hprcc.unl.edu/products/current.html>.
- For precipitation maps like these and those in the previous summaries, which are updated daily visit: <http://www.cdc.noaa.gov/Drought/>.
- For National Climatic Data Center monthly and weekly precipitation and drought reports for Colorado, Utah, Wyoming, and the whole U.S., visit: <http://wlf.ncdc.noaa.gov/oa/climate/research/2002/perspectives.html>.
- For a list of weather stations in Colorado, Utah, and Wyoming, visit: <http://www.wrcc.dri.edu/summary>.



U.S. Drought Monitor conditions as of 4/18/06

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

As of April 18, the drought status of most of the Intermountain West region essentially unchanged from one month ago. **Colorado** drought status increased slightly in the southern part of the state. The southwestern corner entered into D0 (abnormally dry) status and the D2 (severe) status in the southeast expanded

slightly farther north. On the other hand, southern **Utah** moved out of drought from D0 to no drought status. Drought status remained the same in **Wyoming**. Drought continues in the southwestern U.S. with eastern New Mexico and western Arizona in D3 (extreme) drought status.

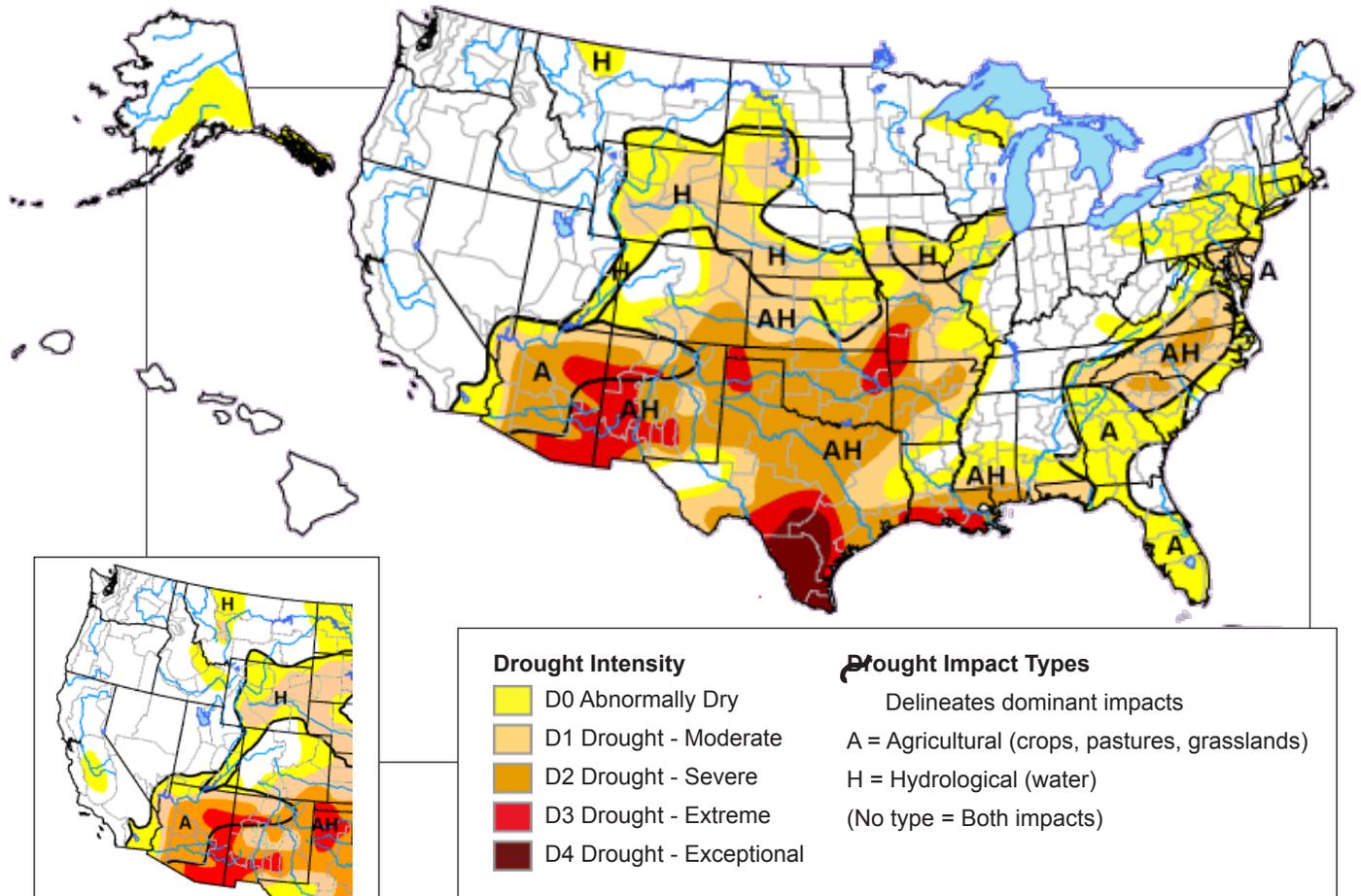


Figure 4. Drought Monitor released April 20, 2006 (full size) and last month March 21, 2006 (inset, lower left) for comparison.

Notes

The U.S. Drought Monitor (Figure 4) is released weekly (every Thursday) and represents data collected through the previous Tuesday. The inset (lower left) shows the western United States from the previous month's map.

The U.S. Drought Monitor maps are based on expert assessment of variables including (but not limited to) the Palmer Drought Severity Index, soil moisture, streamflow, precipitation, and measures of vegetation stress, as well as reports of drought impacts. It is a joint effort of the several agencies; the author of this monitor is Rich Tinker of the NOAA Climate Prediction Center.

On the Web

For the most recent Drought Monitor, visit: <http://www.drought.unl.edu/dm/monitor.html>. This site also includes archives of past drought monitors



Intermountain West Snowpack data through 4/1/06

Source: USDA Natural Resources Conservation Service (NRCS) Water and Climate Center

The snowpack as of April 1, 2006 varies across the Intermountain West Region and throughout the states. **Wyoming's** snowpack as a percent of average has not changed much since March 1. About half of the state of **Wyoming** is near or above average. The Green, the Bear and the Upper Snake River basins in the west, along with part of the Lower North Platte River basin in the south all have between 110% and 129% of average snowpack. The snowpack in the central basins range from near average to 50% of average.

Utah and **Colorado** continue to show a distinct south-to-north gradient in snowpack levels, though southwest and central **Utah** continues to increase in snowpack. The Sevier, Beaver, and Virgin River basins all increased in their percent of average snowpack this month up to between 70% and 109% of average. The Provo, Weber, and Bear River basins continue to have above average snowpack ranging from 110% - 149% of average.

Southern **Colorado** continues to have areas below 50% of average snowpack, while the northern mountains have areas where the snowpack is 110% to 129% of average. This gradient is characteristic of a La Nina pattern, which persisted for most of the winter according to NOAA. (See page 16 for more ENSO information).

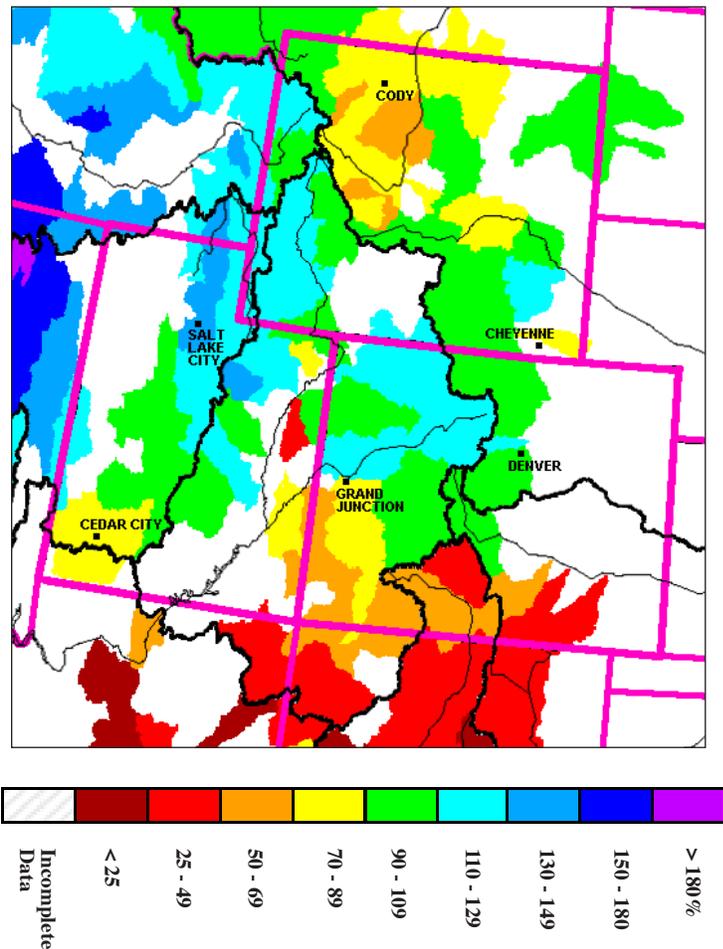


Figure 5. Snow water equivalent (SWE) as a percent of average for available monitoring sites in the Intermountain West as of April 1, 2006.

Notes

Snow water equivalent (SWE) or snow water content (SWC) refers to the depth of water that would result by melting the snowpack at the measurement site. SWE is determined by measuring the weight of snow on a "pillow" (like a very large bathroom scale) at the SNOTEL site. Knowing the size of the pillow and the density of water, SWE is then calculated from the weight measurement. Given two snow samples of the same depth, heavy, wet snow will yield a greater SWE than light, powdery snow. SWE is important in predicting runoff and streamflow. Snowpack-telemetry (SNOTEL) sites are automated stations operated by NRCS that measure snowpack. In addition, SWE is measured manually at other locations called snow courses. (See page X for water supply outlooks.)

Figure 5 shows the SWE based on SNOTEL and snow course sites in the Intermountain West states, compared to the 1971-2000 average values. The number of SNOTEL or snow course sites varies by basin. Individual sites do not always report data due to lack of snow or instrument error, these basins with incomplete data are designated in white on the map. To see the locations of individual SNOTEL sites, see each state's water availability page.

On the Web

For graphs like this and snowpack graphs of other parts of the western U.S., visit: http://www.wcc.nrcs.usda.gov/snowcourse/snow_map.html.

For snow course and SNOTEL data updated daily, please visit one of the following sites:

- River basin data of SWE and precipitation: <http://www.wrcc.dri.edu/snotelanom/snotelbasin>.
- Individual station data of SWE and precipitation for SNOTEL and snow course sites: http://www.wcc.nrcs.usda.gov/snowcourse/snow_rpt.html or <http://www.wcc.nrcs.usda.gov/snotel/>.
- Graphic representations of SWE and precipitation at individual SNOTEL sites: <http://www.wcc.nrcs.usda.gov/snow/snotel-data.html>.



Regional Standardized Precipitation Index data through 3/31/06

Source: Western Regional Climate Center, using data from NOAA National Climatic Data Center and NOAA Climate Prediction Center

The Standardized Precipitation Index (SPI) can be used to monitor conditions on a variety of time scales. 3- and 6-month SPIs are useful in short-term agricultural applications and longer-term SPIs (12 months and longer) are useful in hydrological applications. The 12-month SPI for the Intermountain West region (Figure 6) reflects precipitation patterns over the past 12 months (through the end of March 2005) compared to the average precipitation of the same 12 consecutive months during all the previous years of available data.

As of the end of March 2006, the SPI around the Intermountain West region remains mostly in the near normal to very wet categories, with the exception of southeastern **Colorado** and south-central **Wyoming**. Several climate divisions have moved into wetter categories since the end of February. Only the Upper Platte division in south-central **Wyoming** moved into a dryer category, from near normal to moderately dry. The rest of **Wyoming's** climate divisions are in the near normal to very wet categories. The Big Horn division in northwestern **Wyoming** moved into a wetter category, moderately wet, this month. Most of **Colorado** is in the near normal category, with improvement in the Rio Grande division from moderately dry to near normal. Only the Arkansas basin in the southeastern part of the state is

moderately dry. The eastern half of **Utah** is in the near normal category, while the western half is moderately wet to extremely wet. Three divisions (north central, northern mountains, and south central) moved into wetter categories this month.

Notes

The Standardized Precipitation Index (SPI) is a simple statistic generated from accumulated precipitation totals for consecutive months compared to the historical data for that station. Near normal SPI means that the total precipitation for the past 12 months is near the long-term average for one year. An index value of -1 indicates moderate drought severity and means that only 15 out of 100 years would be expected to be drier. An index value of -2 means severe drought with only one year in 40 expected to be drier. (courtesy of the Colorado Climate Center)

The SPI calculation for any location is based on the long-term precipitation record for a desired period. This long-term record is fitted to a probability distribution, which is then transformed into a normal distribution so that the mean SPI for the location and desired period is zero. Positive SPI values indicate greater than median precipitation, and negative values indicate less than median precipitation. Because the SPI is normalized, wetter and drier climates can be represented in the same way. The SPI is valuable in monitoring both wet and dry periods.

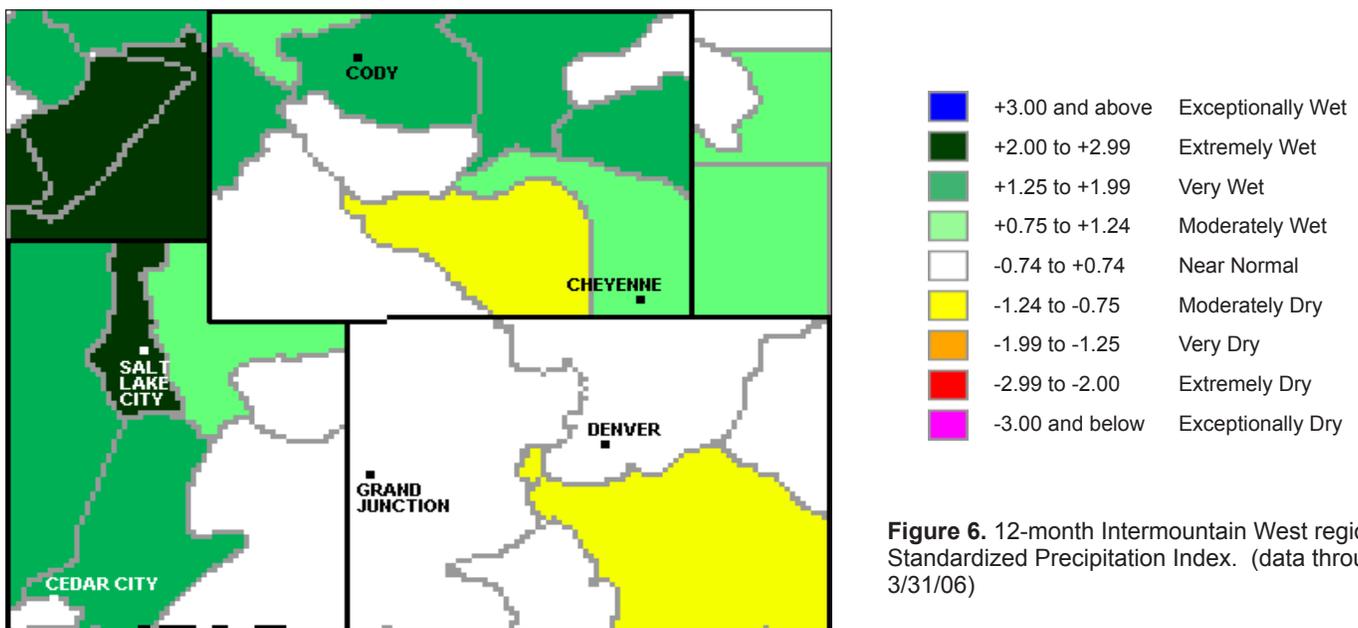


Figure 6. 12-month Intermountain West regional Standardized Precipitation Index. (data through 3/31/06)

On the Web

- For information on the SPI, how it is calculated, and other similar products for the entire country, visit <http://www.wrcc.dri.edu/spi/spi.html>.
- For information on past precipitation trends, visit: <http://www.hprcc.unl.edu/products/current.html>.



Colorado Water Availability April 2006

Source: USDA Natural Resources Conservation Service

Southern Colorado received a boost of snowfall and SWE levels in March. Snotel sites in the San Juan mountains of southwestern Colorado bordering the Rio Grande and San Juan basins increased from 40% - 60% of average last month to 60% - 80% of average this month. According to the NRCS, given these improvements to the snowpack, comparisons to the drought year of 2002 are no longer applicable. The north-central mountains received below-average snowfall in March, but they continue to have from 80% to 140% of average SWE. (See Figure 7a.)

The Surface Water Supply Index (SWSI) is another useful measure of water availability related to streamflows, reservoir levels, and groundwater levels. The SWSI graphic shows that all the river basins in Colorado have generally near normal surface water supplies (Figure 7b). However, the Rio Grande and combined San Miguel, Dolores, Animas and San Juan basins in southern Colorado have SWSI numbers in the end of the near normal range, -1.5 and -1.3, respectively.

Although the SWSI does not indicate drought, there is still a strong possibility for significant late summer shortages across southern Colorado. According to the NRCS, even with the additional snowfall across the southern basins during March, water supply forecasts remain critically low in many basins of southern Colorado this year. The Rio Grande and Arkansas basins have below average reservoir storage, but the rest of the state is at or above average.

Notes

Figure 7a shows the SWE as a percent of normal (average) for SNOTEL sites in Colorado. Figure 7b shows the Surface Water Supply Index (SWSI), developed by the Colorado Office of the State Engineer and the USDA Natural Resources Conservation Service. SWSI is used as an indicator of mountain-based water supply conditions in the major river basins of the state and is based on snowpack, reservoir storage, and precipitation for the winter period (November through April). During the winter period, snowpack is the primary SWSI component in all basins except the South Platte Basin where reservoir storage is given the most weight. The SWSI values in Figure 7b were computed for each of the seven major basins in Colorado for April 1, 2006, and reflect conditions through the month of March 2005.

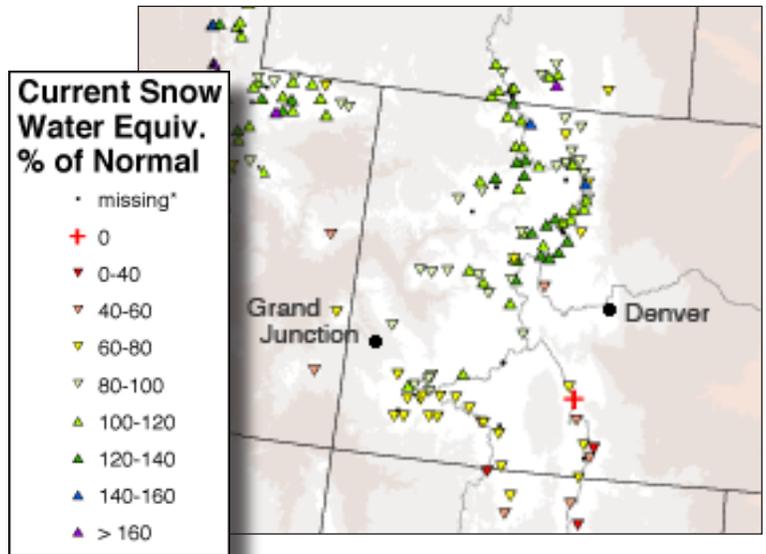


Figure 7a. Current snow water equivalent (SWE) as a percent of normal for SNOTEL sites in Colorado as of April 5, 2006. **This is provisional data.** For current SNOTEL data and plots of specific sites, see <http://www.cbrfc.noaa.gov/snow/snow.cgi> or <http://www.wcc.nrcs.usda.gov/snow/>.

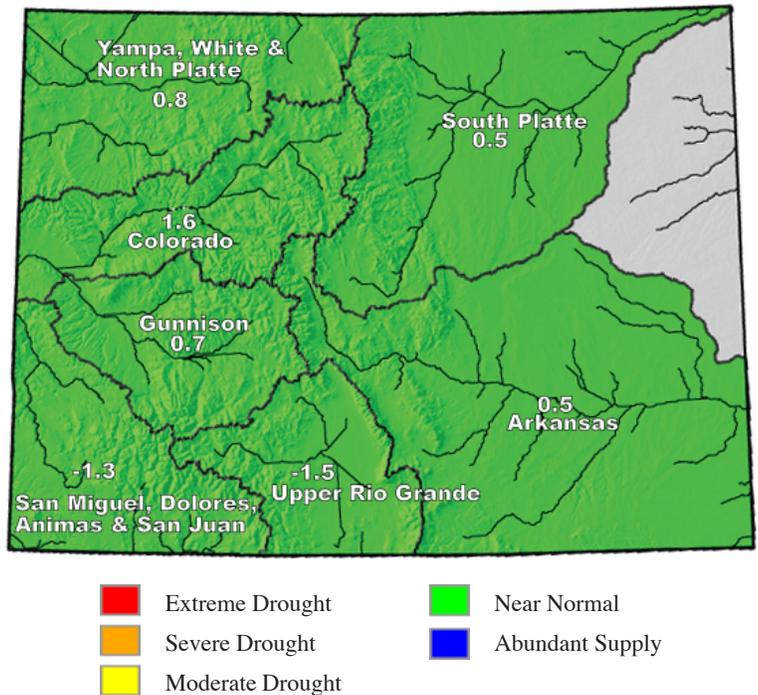


Figure 7b. Colorado Surface Water Supply Index. The map shows the projected water availability by basin for spring and summer 2006, based on current conditions as of April 1, 2006.

On the Web

- For current maps of SWE as a percent of normal like in Figure 7a, go to: <http://www.wcc.nrcs.usda.gov/gis/snow.html>.
- For the current SWSI map, go to: http://www.co.nrcs.usda.gov/snow/fcst/state/current/monthly/maps_graphs/index.html.
- For current streamflow information from USGS, visit: <http://water.usgs.gov/waterwatch/>.
- For monthly reports on the water supply conditions and forecasts for major river basins in Colorado, go to http://www.co.nrcs.usda.gov/snow/snow/snow_all.html and click on "Basin Outlook Reports."



Wyoming Water Availability April 2006

Source: Wyoming Water Resources Data System and USDA Natural Resources Conservation Service

Wyoming continues to have a higher snowpack in the Colorado River basin in the west than in the rest of the state (Figure 8a). The south-central mountains of the Upper North Platte basin and the western mountains of the Upper Snake, Upper Bear, Big Sandy and Lower Green River basins continue to have above average snowpack levels, ranging from 100% - 140% of average SWE. The central mountains bordering the Big Horn and Powder River basins only have 60% - 120% of average SWE. Some stations in the Big Horn Wind River basins have less than 40% of average SWE.

The Surface Water Supply Index (SWSI) values show similar patterns of spatial distribution to the snowpack map (Figure 8b). The driest basins continue to be the Wind and Powder Rivers, which are now both in the moderate drought categories. The Big Horn and Lower North Platte River basins are moving towards mild drought with lower SWSI numbers than last month. The Upper Snake, Upper Bear, Big Sandy, and Lower Green River basins all continue to be in the slightly to moderately wet category.

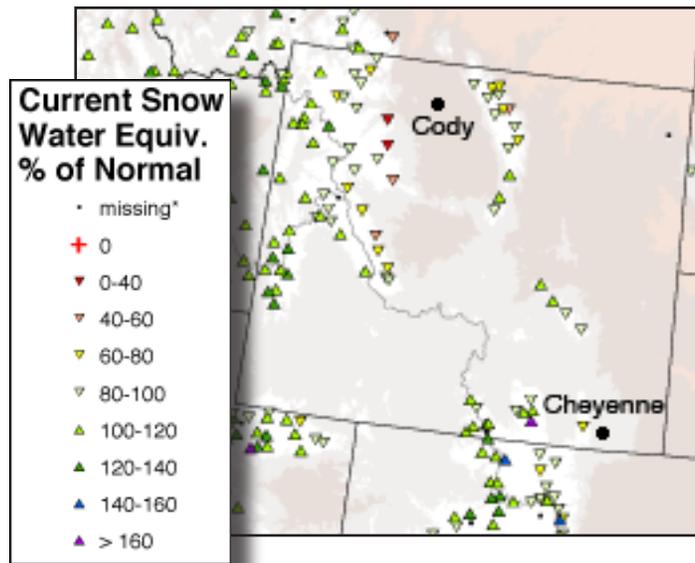


Figure 8a. Current snow water equivalent (SWE) as a percent of normal for SNOTEL sites in Wyoming as of April 5, 2006. **This is provisional data.** For current SNOTEL data and plots of specific sites, see <http://www.wcc.nrcs.usda.gov/snow/>.

Notes

Figure 8a shows the SWE as a percent of average for each of the major river basins in Wyoming. According to WY NRCS, "The Surface Water Supply Index (SWSI-Figure 8b) is computed using only surface water supplies for the drainage. The computation includes reservoir storage, if applicable, plus the forecast runoff. The index is purposely created to resemble the Palmer Drought Index, with normal conditions centered near zero. Adequate and excessive supply has a positive number and deficit water supply has a negative value. Soil moisture and forecast precipitation are not considered as such, but the forecast runoff may consider these values."

Legend

- > 4.0 Extremely Wet
- 3.0 Very Wet
- 2.0 Moderately Wet
- 1.0 Slightly Wet
- 0.5 Incipient Wet Spell
- 0.0 Near Normal
- 0.5 Incipient Dry Spell
- 1.0 Mild Drought
- 2.0 Moderate Drought
- 3.0 Severe Drought
- < -4.0 Extreme Drought

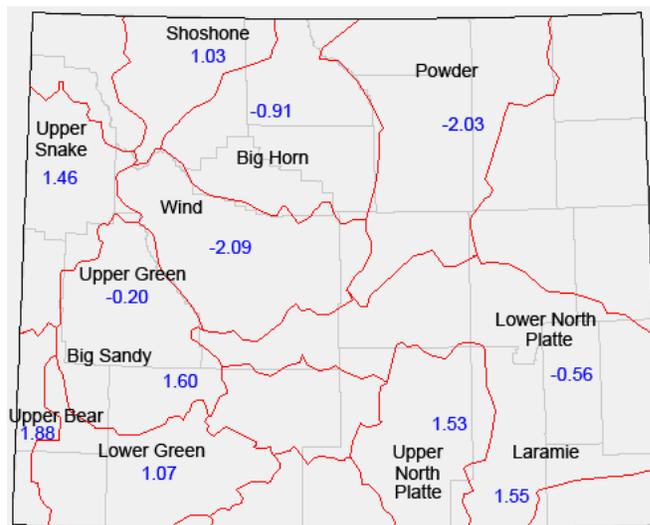


Figure 8b. Wyoming Surface Water Supply Index (data through 4/1/06)

On the Web

- Information on current Wyoming snowpack, SWE, and SWSI, along with more data about current water supply status for the state, can be found at: <http://www.wrds.uwyo.edu/wrds/nrcs/nrcs.html>.
- The Palmer Drought Index is found on NOAA's drought page: www.drought.noaa.gov.
- For current streamflow information from USGS, visit: <http://water.usgs.gov/waterwatch/>



Utah Water Availability April 2006

Source: USDA Natural Resources Conservation Service and the Colorado Basin River Forecast Center

In March snowpacks as a percent of average improved across most of Utah (Figure 9a). Utah's weather pattern in March was different from the rest of the winter; there was more snowfall in the southern mountains and less in the northern mountains. In general, the snowpacks in northern Utah at or above average. Southern Utah was very low, but had substantial improvement in March in most areas. According to the NRCS, southern Utah received 415% of average increase in snow accumulation last month, which helped to bring those basins up to 80% to 100% of average snowpack, but some areas remain below that level. Some SnoTel sites in the Weber basin of northern Utah are reporting over 160% of average snowpack. Sites in the Provo and Sevier basins of central Utah are reporting 100% to 140% of average as of April 5, 2006.

The Utah Surface Water Supply Index (SWSI) shows a similar pattern to the SNOTEL sites, with more water available in the northern part of the state (Figure 9b). The southern basins are low, but only the Moab is below zero, which is a big improvement over last month. With the exception of the Bear basin, which has the lowest SWSI at -2.39, the northern basins are above average.

According to Brian McNerney, hydrologist for the NWS Weather Forecast Office in Salt Lake City, spring climate will dictate the runoff scenario. Soil moisture is near saturation in the northern part of the state and runoff conditions could go two ways primarily determined by temperature. A cool wet spring will enhance runoff efficiency and heighten flood potential, while a warmer drier spring means more evaporation and lower water volume, which lessens flood potential.

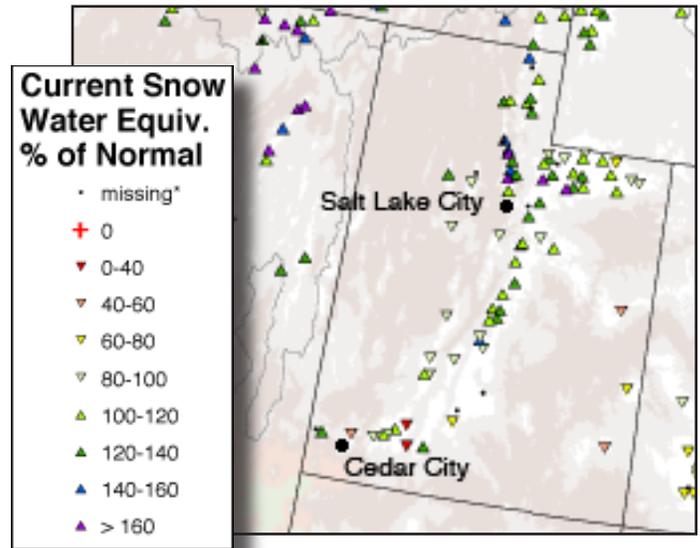


Figure 9a. Current snow water equivalent (SWE) as a percent of normal for SNOTEL sites in Utah as of April 5, 2006. This is provisional data. For current SNOTEL data and plots of specific sites, see <http://www.cbrfc.noaa.gov/snow/snow.cgi> or <http://www.wcc.nrcs.usda.gov/snow/>

Notes

Figure 9a shows the SWE as a percent of normal (average) for SNOTEL sites in Utah. According to the UT NRCS, "The Surface Water Supply Index (SWSI) is a predictive indicator of total surface water availability within a watershed for the spring and summer water use seasons. The index is calculated by combining pre-runoff reservoir storage (carryover) with forecasts of spring and summer streamflow, which are based on current snowpack and other hydrologic variables. SWSI values (Figure 9b) are scaled from +4.1 (abundant supply) to -4.1 (extremely dry) with a value of zero (0) indicating median water supply as compared to historical analysis. SWSI's are calculated in this fashion to be consistent with other hydroclimatic indicators such as the Palmer Drought Index and the [Standardized] Precipitation Index." See page 9 for the SPI.

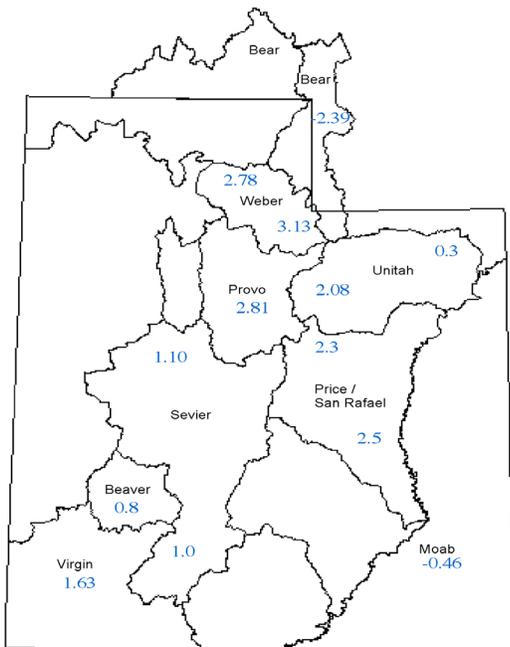


Figure 9b. Utah Surface Water Supply Index (data through 4/1/06).

On the Web

- For current maps of SWE as a percent of normal like in Figure 9a, go to: <http://www.wcc.nrcs.usda.gov/gis/snow.html>.
- The Utah SWSI, along with more data about current water supply status for the state, can be found at: <http://www.ut.nrcs.usda.gov/snow/watersupply/>.
- The Palmer Drought Index is found on NOAA's drought page: www.drought.noaa.gov
- For current streamflow information from USGS, visit: <http://water.usgs.gov/waterwatch/>



Temperature Outlook May - September 2006

Source: NOAA Climate Prediction Center

The temperature outlook issued on April 20th has not changed appreciably since the March 2006 forecasts. According to the NOAA Climate Prediction Center, a large area of the southern and western U.S., including much of southern Utah and Colorado, has an increased risk of above average temperatures in May 2006 (Figure 10a). For the May-June-July forecast period there is a 50% probability that temperatures will be in the warmest tercile in much of the U.S. Southwest, including southern Utah and Colorado. For forecast periods through the summer of 2006, a large area of western the U.S. is likely to have above normal temperatures, including much of Utah, Colorado and part of Wyoming (Figure 10b-d). The only below normal risk is for the upper Great Plains including parts of Wyoming in the May forecast period.

The forecast for May 2006 will be updated on April 30th. Last year, CPC began updating its forecast for the next month on the last day of the previous month. This “zero-lead” forecast often can take advantage of long-lead weather forecasts and typically has increased skill over the forecast made mid month because of the shorter lead time. This forecast is available on the same CPC webpages as the regular mid-month forecasts.

Notes

The seasonal temperature outlooks in Figures 10a-d predict the likelihood (chance) of *above-average*, *near-average*, and *below-average* temperature, but not the magnitude of such variation. The numbers on the maps refer to the percent chance that temperatures will be in one of these three categories, they do not refer to actual temperature values.

The NOAA-CPC outlooks are a 3-category forecast based largely on the status of El Niño and recent trends. As a starting point, the 1971-2000 climate record for each particular 1 or 3 month period is divided into 3 categories or terciles, each with a 33.3 % chance of occurring. The middle tercile is considered the *near-average* (or normal) temperature range. The forecast indicates the likelihood of the temperature being in one of the warmer or cooler terciles--*above-average* (A) or *below-average* (B)--with a corresponding adjustment to the opposite category; the near-average category is preserved at 33.3% likelihood, unless the anomaly forecast probability is very high. For a detailed description of how this works, see notes on the following page.

Equal Chances (EC) indicates areas for which the models cannot predict the temperature with any confidence. EC is used as a “default option” representing equal chances or a 33.3% probability for each tercile, indicating areas where the reliability (i.e., ‘skill’) of the forecast is poor.

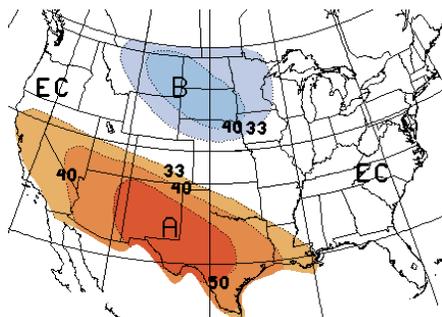


Figure 10a. Long-lead national temperature forecast for May 2006. (released Apr. 20, 2006)

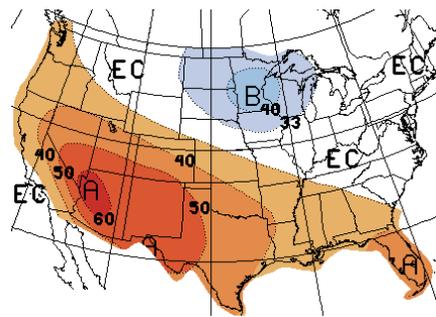


Figure 10b. Long-lead national temperature forecast for May - Jul. 2006. (released Apr. 20, 2006)

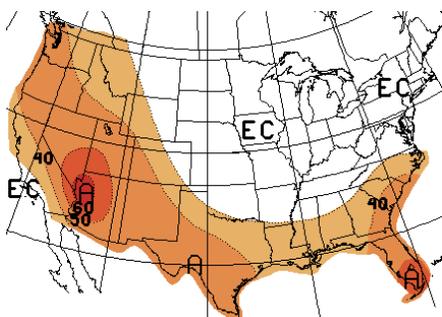


Figure 10c. Long-lead national temperature forecast for Jun. - Aug. 2006. (released Apr. 20, 2006)

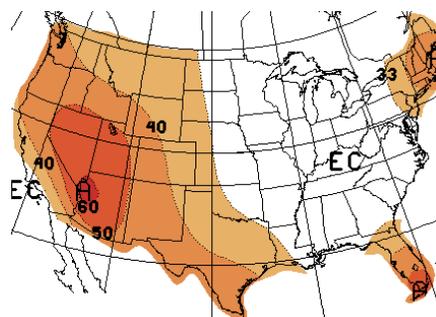
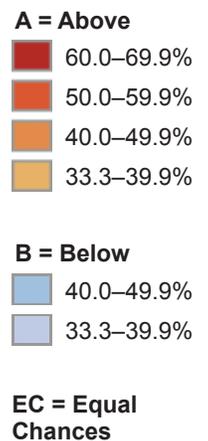


Figure 10d. Long-lead national temperature forecast for Jul. - Sep. 2006. (released Apr. 20, 2006)



On the Web

- For more information and the most recent forecast images, 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.
- The CPC “discussion for non-technical users” is at: <http://www.cpc.noaa.gov/products/predictions/90day/fxus05.html>
- For IRI forecasts, visit: http://iri.columbia.edu/climate/forecast/net_asmt/.
- More information about temperature distributions at specific stations in Colorado, Utah, Wyoming, and across the West can be found at the Western Regional Climate Center, <http://www.wrcc.dri.edu/CLIMATEDATA.html>.



Precipitation Outlook May - September 2006

Source: NOAA Climate Prediction Center

The winter and spring seasonal precipitation forecasts issued April 20th by the NOAA Climate Prediction Center (CPC) show the Intermountain West as having “equal chances” of above-average, near-normal or below-average precipitation for the May 2006 forecast period (Figure 11a), for the June-August forecast periods (Figure 11c-d), and beyond. Forecast methodologies are unable to make any other predictions for the region through the forecast period due to a lack of strong predictive signals from ENSO or other sources. La Niña conditions have weakened and its effect on the climate of the North American region, including the Intermountain West, for the next season or two is expected to be weak. However, there is a slightly increased chance of below normal precipitation in much of the western Great Plains for the May-July period (Figure 11b), including all of **Colorado** and **Wyoming**. This is consistent with last month’s forecast for April-May-June 2006 which called for drier than normal conditions in the western portions of the central and southern Plains, including southern **Utah** and **Colorado**. Last month’s forecast also indicated increased probability of a slightly enhanced summer monsoon, but that enhancement is no longer in the forecast.

Note that the May precipitation forecast will be updated in on April 30th and may provide more forecast information. Last year, CPC began updating its one month forecast on the last day of the previous month. This “zero-lead” forecast often can take advantage of long-lead weather forecasts and typically has increased skill over the forecast made mid month because of the shorter lead time. This forecast is available on the same CPC webpages as the

regular mid-month forecasts.

Notes

The seasonal precipitation outlooks in Figures 11a-d predict the likelihood (chance) of *above-average*, *near-average*, and *below-average* precipitation, but not the magnitude of such variation. The numbers on the maps refer to the percent chance that precipitation will be in one of these three categories, they do not refer to inches of precipitation.

The NOAA-CPC outlooks are a 3-category forecast based largely on the status of El Niño and recent trends. As a starting point, the 1971-2000 climate record for each particular 1 or 3 month period is divided into 3 categories or terciles, each with a 33.3% chance of occurring. The middle tercile is considered the *near-average* (or normal) precipitation range. The forecast indicates the likelihood of the precipitation being in one of the wetter or drier terciles--*above-average* (A) or *below-average* (B)--with a corresponding adjustment to the opposite category; the near-average category is preserved at 33.3% likelihood, unless the anomaly forecast probability is very high.

Thus, using the NOAA-CPC precipitation outlook, areas with light brown shading display a 33.3-39.9% chance of below-average, a 33.3% chance of near-average, and a 26.7-33.3% chance of below-average precipitation. A darker brown shade indicates a 40.0-50.0% chance of below-average, a 33.3% chance of near-average, and a 16.7-26.6% chance of below-average precipitation, and so on. Correspondingly, green shades are indicated for areas with a greater chance of above average precipitation.

Equal Chances (EC) indicates areas for which the models cannot predict the precipitation with any confidence. EC is used as a “default option” representing equal chances or a 33.3% probability for each tercile, indicating areas where the reliability (i.e., ‘skill’) of the forecast is poor.

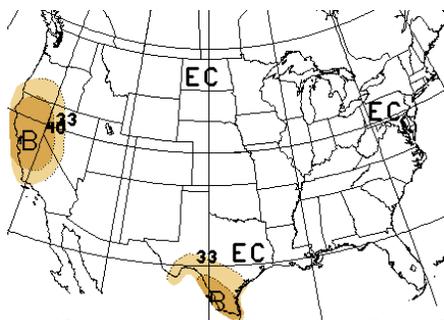


Figure 11a. Long-lead national precipitation forecast for May 2006. (released Apr. 20, 2006)

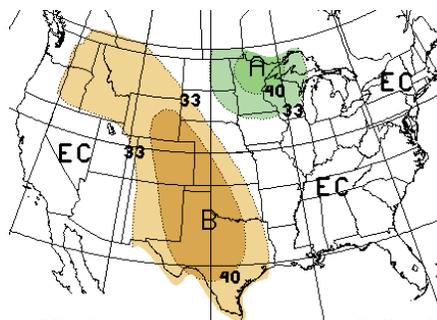


Figure 11b. Long-lead national precipitation forecast for May - Jul. 2006. (released Apr. 20, 2006)

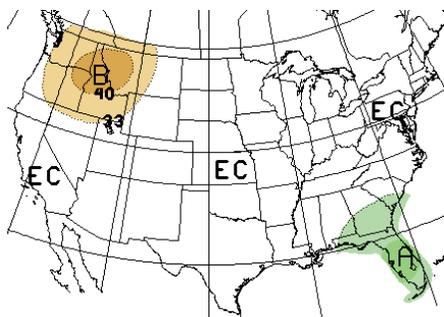


Figure 11c. Long-lead national precipitation forecast for Jun. - Aug. 2006. (released Apr. 20, 2006)

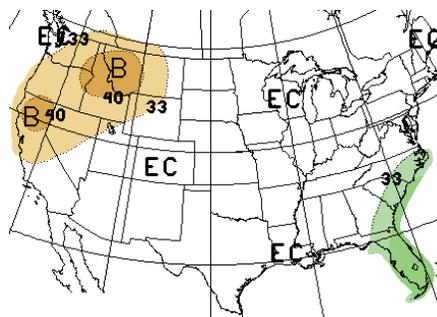


Figure 11d. Long-lead national precipitation forecast for Jul. - Sep. 2006. (released Apr. 20, 2006)

- A = Above**
 - 40.0–49.9%
 - 33.3–39.9%
- B = Below**
 - 40.0–49.9%
 - 33.3–39.9%
- EC = Equal Chances**

On the Web

- For more information and the most recent CPC forecast images, 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.
- The CPC “discussion for non-technical users” is at: <http://www.cpc.ncep.noaa.gov/products/predictions/90day/fxus05.html>
- For IRI forecasts, visit: http://iri.columbia.edu/climate/forecast/net_asmt/.
- More information about temperature distributions at specific stations in Colorado, Utah, Wyoming, and across the West can be found at the Western Regional Climate Center, <http://www.wrcc.dri.edu/CLIMATEDATA.html>.
- The CDC experimental guidance product, including a discussion and executive summary, is available on the web at: <http://www.cdc.noaa.gov/people/klaus.wolter/SWcasts/index.html>



Seasonal Drought Outlook through July 2006 Source: NOAA Climate Prediction Center

The seasonal drought outlook for the period of May through July 2006 predicts intensification of drought status in southern and eastern **Colorado** and central and eastern **Wyoming** (Figure 12). According to NOAA's Climate Prediction Center (CPC), southern **Colorado** is in D0 to D2 drought status on the Drought Monitor (see page 7), although moderate spring moisture has brought some relief to parts of the region. Despite the short-term relief, the CPC seasonal outlooks indicate that the spring will bring above-average temperatures and below-average precipitation for **Colorado** (see pages 13 and 14 for temperature and precipitation outlooks). As a result, drought conditions which have intensified in eastern and southern **Colorado** and are expected to persist, with possible further expansion from the Great Plains.

Drought conditions for south-central and eastern **Wyoming** have intensified moving from some improvement into persistent drought status. Drought conditions are not indicated for **Utah**.

Notes

The delineated areas in the Seasonal Drought Outlook (Figure 12) are defined subjectively and are based on expert assessment of numerous indicators, including outputs of short- and long-term forecasting models. "Ongoing" drought areas are schematically approximated from the Drought Monitor (D1 to D4). For weekly drought updates, see the latest Drought Monitor text on the website: <http://www.drought.unl.edu/dm/monitor.html>. NOTE: The green improvement areas imply at least a 1-category improvement in the Drought Monitor intensity levels, but do not necessarily imply drought elimination.

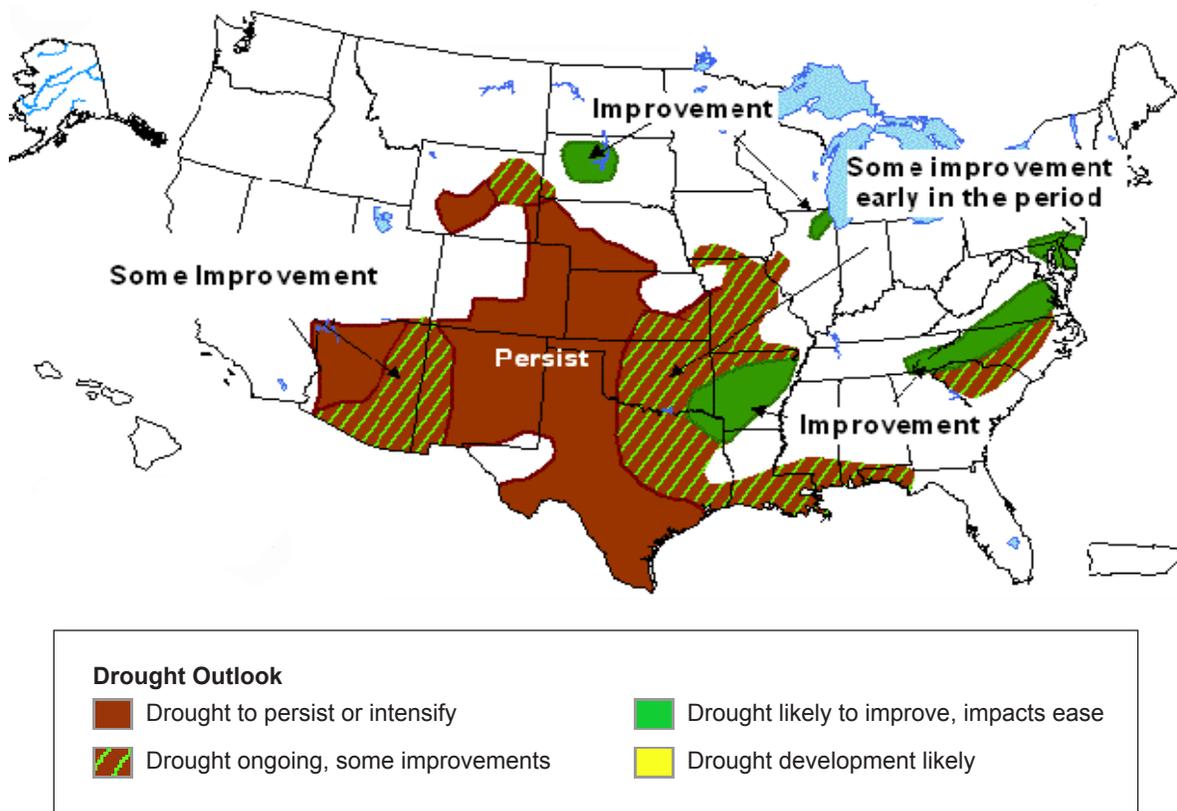


Figure 12. Seasonal Drought Outlook through July 2006 (release date April 20, 2006).

On the Web

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



El Niño Status and Forecast

Source: NOAA Climate Prediction Center, International Research Institute For Climate and Society

According to both the NOAA CPC and the International Research Institute for Climate and Society (IRI), La Niña conditions have weakened rapidly and ENSO-neutral conditions have returned to the tropical Pacific (Figure 13a). The status of ENSO has changed significantly over the last month or so. La Niña weakened rapidly as SST anomalies across much of the central and eastern equatorial Pacific decreased to within half a degree centigrade of average by mid-April, from their greatest anomalies late January of 2006 (Figure 13b). NOAA's definition of a La Niña is based on a 3-month running average of SSTs (see notes), so the system is still defined to be in a La Niña, although conditions are changing.

Although La Niña conditions persist in some models (Figure 13b), CPC's prognostic discussion for long-lead seasonal outlooks forecast says that ENSO-neutral conditions are the most likely for most of the rest of the year. This prediction is in agreement with the IRI forecast of a 75% probability of neutral conditions continuing through the April-May-June season. No impacts from ENSO on the north American region -- including the Intermountain West -- are anticipated, at least through summer.

Notes

Two graphics in Figure 13a produced by NOAA show the observed SST (upper) and the observed SST anomalies (lower) in the Pacific Ocean. This data is from the TOGA/TAO Array of 70 moored buoys spread out over the Pacific Ocean, centered on the equator. These buoys measure temperature, currents and winds in the Pacific equatorial band and transmit data in real-time. NOAA uses these observations to predict short-term (a few months to one year) climate variations.

Figure 13b shows multiple forecasts for SST in the Niño 3.4 region for nine overlapping 3-month periods from September 2005 to July 2006. "Niño 3.4" refers to the region of the equatorial Pacific from 120°W to 170°W and 5°N to 5°S, which is one basis for defining ENSO sea surface temperature anomalies. Initials at the bottom of the graph represent groups of three months (e.g. SON = Sept-Nov). The expected skills of the models, based on historical performance, are not equal to one another. The skills also generally decrease as the lead-time increases. Forecasts made at some times of the year generally have higher skill than forecasts made at other times of the year. They are better when made between June and December than between February and May. Differences among the forecasts of the models reflect both differences in model design and actual uncertainty in the forecast of the possible future SST scenario.

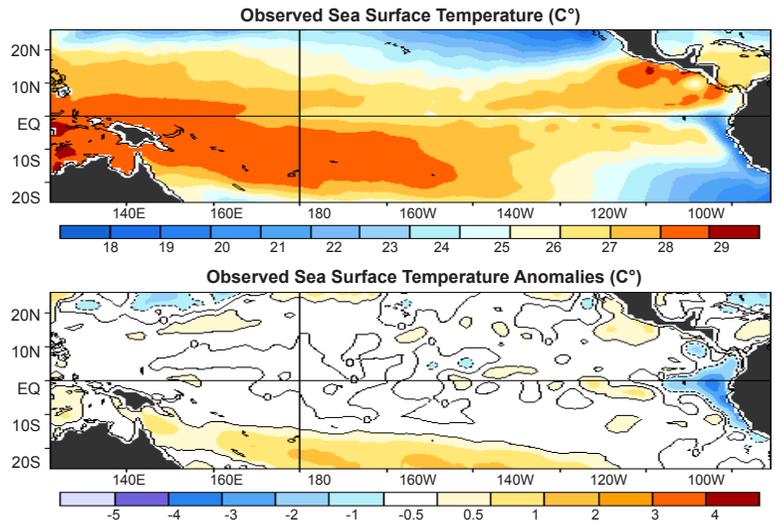


Figure 13a. Two graphics showing the observed SST (upper) and the observed SST anomalies (lower) in the Pacific Ocean. The Niño 3.4 region encompasses the area between 120°W-170°W and 5°N-5°S. The graphics represent the 7-day average centered on April 5, 2006.

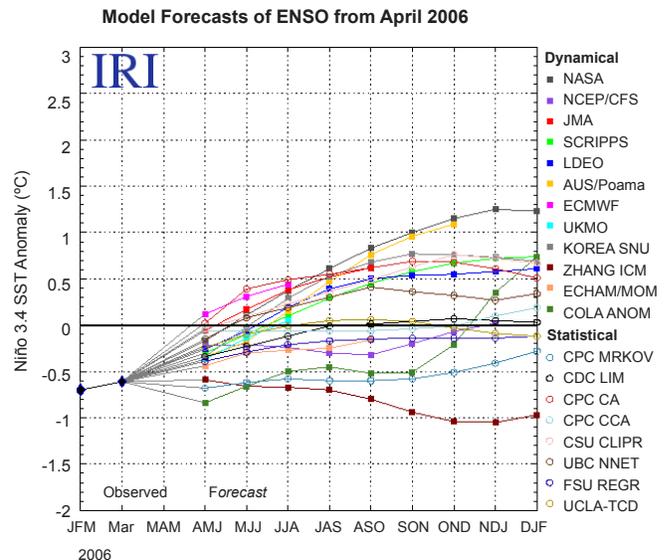


Figure 13b. Forecasts made by dynamical and statistical models for sea surface temperatures (SST) in the Niño 3.4 region for nine overlapping 3-month periods from March 2006 through January 2007 (released March 15, 2006). Forecasts are courtesy of the International Research Institute (IRI) for Climate and Society.

On the Web

- For a technical discussion of current El Niño conditions, visit: http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/ens0_advisory/.
- For updated graphics of SST and SST anomalies, visit this site and click on "Weekly SST Anomalies": <http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/ens0.shtml#current>.
- For more information about El Niño, including the most recent forecasts, visit: <http://iri.columbia.edu/climate/ENSO/>.



Water Supply Outlook for the 2006 runoff Season

Source: Wyoming Water Resources Data System and USDA Natural Resources Conservation Service

Overall, water supplies across the region are projected to be average or above average in northern **Colorado**, southern **Wyoming** and most of north-central and eastern **Utah**. The water supply outlook for the Intermountain West Region as of April 1 (Figure 14) has several areas of increased streamflow forecasts since last month. March storms brought much needed snow to southern Utah and **Colorado** raising many basins in that area from below 50% average projected streamflows to the 50% to 69% category. In **Utah**, streamflow forecasts in areas of the Sevier River basin streamflow outlooks improved to 90% to 109% of average from below 50% of average. **Wyoming** continues to have some areas of the Big Horn, Wind, and Powder River basins in the north-central part of the state that are projected to have streamflows that are 70% to 89% of average.

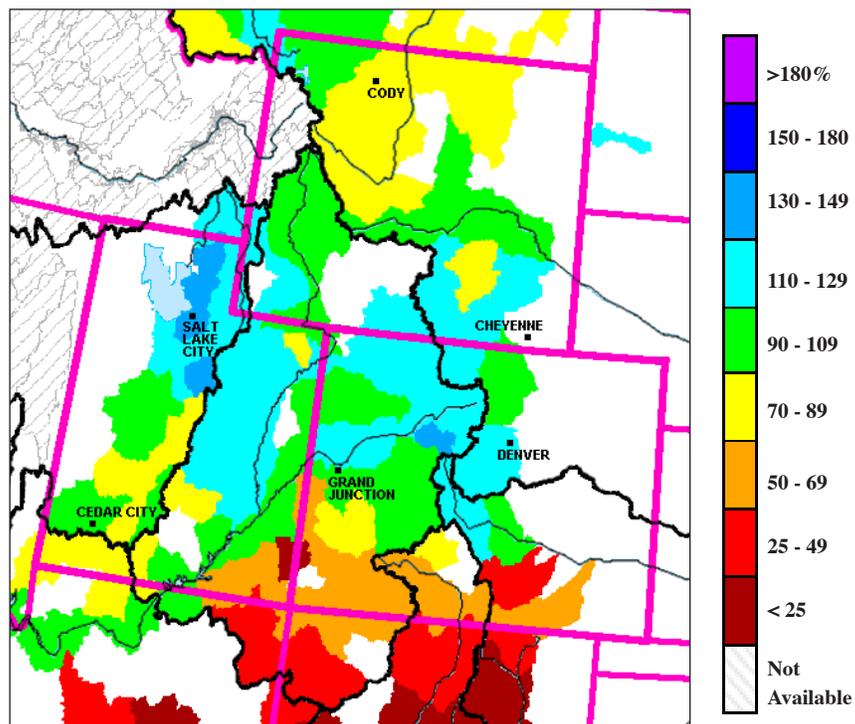


Figure 14. NRCS map showing the expected natural streamflows for spring and summer in the Intermountain West region as a percent of average streamflows. (data through April 1, 2006)

Notes

The map on this page does not display the official NOAA streamflow forecast, official forecasts are developed by individual river basin forecast centers. (See 'On the Web' box below for links to the official forecasts.) We present the NRCS water supply forecasts because they show the entire Intermountain West region together.

Figure 14 shows the forecasts of natural runoff, based principally on measurements of precipitation, snow water equivalent, and antecedent runoff (in

fluenced by precipitation in the fall before it started snowing). Forecasts become more accurate as more of the data affecting runoff are measured (i.e. accuracy increases from January to May). In addition, these forecasts assume that climatic factors during the remainder of the snow accumulation and melt season will have an average affect on runoff. Early season forecasts are, therefore, subject to a greater change than those made on later dates.

On the Web

For more information about NRCS water supply forecasts based on snow accumulation and access to the graph on this page, visit: <http://www.wcc.nrcs.usda.gov/wsf/>.

The official NOAA streamflow forecasts are available through the following websites of individual River Forecast Centers:

- Colorado Basin (includes Great Basin): <http://www.cbrfc.noaa.gov/>
- Missouri Basin (includes South Platte and North Platte): <http://www.crh.noaa.gov/mbrfc/>
- West Gulf (includes Rio Grande): <http://www.srh.noaa.gov/wgrfc/>
- Arkansas Basin: <http://www.srh.noaa.gov/abrfc/>





The Arkansas Basin River Forecasting Center (ABRFC)

By Keah Schuenemann and Eileen McKim, Western Water Assessment

The Arkansas Basin River Forecasting Center is located in Tulsa, Oklahoma. The mission of the ABRFC is to provide technical support to the National Weather Service’s efforts to provide river and flood forecasts and warnings for protection of life and property and to provide basic hydrologic forecast information for the nation’s economic and environmental well-being.

The ABRFC is responsible for providing river and flood forecasts and warnings for the Arkansas River above Pine Bluff, Arkansas and the Red River drainage area above Fulton, Arkansas.

control of data. The hydrologic forecaster is responsible for the production of river forecasts, flash flood guidance, data summary products, running the river forecast computer model, and the coordination of river forecasts on a daily basis. The hydro-meteorologic analysis and support forecaster is responsible for preparing the precipitation and temperature data input for the river forecast model. That forecaster is also in charge of the hydrometeorologic discussion product and the coordination with the NWS Forecast Offices. On a seasonal basis, water supply forecasts, flood outlooks, and drought summaries are also put out by the ABRFC.

The ABRFC hydrometeorologists provide precipitation forecasts. Quantitative Precipitation Forecasts (QPF) are predictions of precipitation amounts over an area. The ABRFC creates QPF forecasts for the Arkansas-Red Basin three times a day (00z, 12z, and 18z). Six-hour increments for the next 24 hour period are used as an input into the ABRFC hydrologic model. The ABRFC uses all 24 hours of QPF to determine the River Flood Outlook. However, due to the limitations of precipitation forecasting, the ABRFC only uses 12 hours of QPF for forecasting river stages. The ABRFC also provides water supply forecasts. The ABRFC issues water supply forecasts and images monthly from January through May of each year. Colorado forecasts are for the period April through September, while New Mexico forecasts are for the period March through June. New forecasts become available by the fifth working day of that month. These forecasts are used by water management agencies in their decision-making processes. These products are both text and graphical.

The ABRFC also produces a quarterly newsletter called The Gage (Figure 15b). This newsletter includes multiple articles with seasonal information important to the Arkansas-Red Basin area. All of this information, along with the climatology of the area, and articles from The Gage, is available on the ABRFC website. Interactive maps on the website allow the user to view the specific area of interest and any hydrological information for that area.

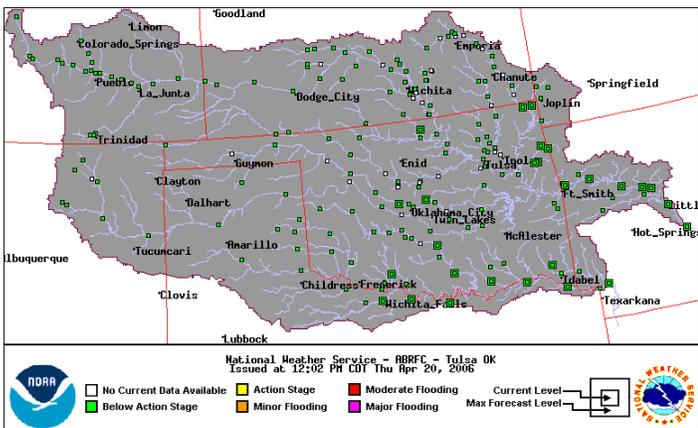


Figure 15a: Map of the ABRFC area including major cities. This map is a forecast point status for flooding in the Arkansas-Red Basin.

This area includes parts of seven states in and around Oklahoma and covers 208,000 square miles. Southeastern Colorado and northeastern New Mexico are included in the area covered by the ABRFC. Major cities within the ABRFC area include Colorado Springs, CO; Dodge City and Wichita, KS; Oklahoma City, OK; and Amarillo, TX among others (Figure 15a).

Record floods in the spring of 1945 in the Arkansas and Red River basins prompted the founding of the “Tulsa River Forecast Center” in December of 1947, renamed the Arkansas Basin River Forecast Center in 1991. The ABRFC was the prototype RFC for modern technologies and operations. It developed many advanced techniques and procedures that are used in hydrometeorological operations today.

The 15 person staff includes both hydrologists and meteorologists. Together, they are responsible for hydrologic forecasting, hydrometeorologic analysis and support, and quality



Figure 15b: The Gage is a quarterly newsletter produced by the ABRFC.

On the Web

- For more information about ABRFC, visit their website at: <http://www.srh.noaa.gov/abrfc/>
- This article was adapted from an article found at: <http://www.srh.noaa.gov/abrfc/aboutpage.shtml>.

