

# INTERMOUNTAIN WEST CLIMATE SUMMARY



by The Western Water Assessment

Issued May 19, 2006

## May 2006 Climate Summary

**Hydrologic Conditions:** Drought status has worsened in eastern Colorado and is likely to persist in eastern and southern Colorado and parts of Wyoming. Water supply forecasts for the season are lower than April 1st due to warm, dry conditions in most areas, although current reservoir storage is average for this year due to early runoff.

**Temperature:** Temperatures were above average for much of the region for April.

**Precipitation/Snowpack:** Precipitation has been below average since April 1 for most of Colorado and Wyoming, but above average in northern Utah.

**ENSO:** La Niña conditions have diminished and ENSO-neutral conditions are expected to prevail through the summer; ENSO is not a significant factor in U.S. climate for the summer.

**Climate Forecasts:** CPC outlooks project above average temperatures for all or most of the Intermountain West region through September forecast periods, and equal chances of above, around normal, or below normal precipitation.

## WARM AND DRY WEATHER LEADS TO DECREASES IN RUNOFF FORECASTS

The water supply picture for for the Intermountain West has changed dramatically since April 1. Although snowpacks throughout the region were near average on April 1 (with some exceptions), unseasonably warm and dry conditions in the intervening 6 weeks has changed the spring runoff outlook significantly. For example, the water supply inflow forecast for Lake Powell was 97% of average on April 1, dropped to 86% of average on May 1 and to 80% of average on May 15. Forecasted inflow into Blue Mesa Reservoir has dropped from 94% on April 1 to 73% of average on May 15. In contrast, most of Utah appears to remain in average to wet conditions, despite some warmth and dryness during April and early May.

An interesting situation in the Colorado Front Range has developed regarding high versus low elevation snowpack, according to the Long-term Ecological Research station at the University of Colorado (<http://culter.colorado.edu/NWT>). Elevations less than about 10,500 feet are very dry now although they had near or above normal snowpacks until April. The Niwot



Ridge SNOTEL site exhibited a decline in snowpack from March to April of approximately 50%, exceeded only by the drought year of 2002. Higher elevations, in stark contrast, have maintained a healthy snowpack. Anecdotal reports on the Front Range indicate that the widespread loss of snowpack was not accompanied by increasing streamflow. Variations among SNOTEL sites at different elevations lead to uncertainties in water supply calculations and differences among calculations by various Front Range water suppliers using different SNOTEL sites, which are further complicated by differences in water rights priorities.

The evolving conditions this spring illustrate how the actual weather may vary from the climatological averages used in forecasting water supply. Spring and summer weather is notoriously difficult to predict and hence conditions may change over the remainder of the runoff season. Close monitoring of conditions is in order for those interested in water supply calculations.

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

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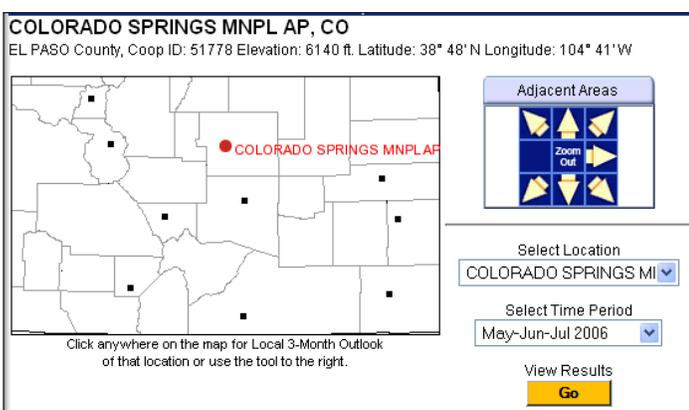
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# NOAA's National Weather Service Introduces New Local Climate Products

By Andrea Bair<sup>1</sup>, Marina Timofeyeva<sup>2,3</sup>, Jenna Meyers<sup>1</sup>, and Annette Hollingshead<sup>2,4</sup>

NOAA's National Weather Service (NWS) will debut a new local seasonal temperature outlook, beginning in late July 2006. This product, called the Local 3-Month Temperature Outlook (L3MTO), is the first in a series of local climate products being developed and released by the NWS over the next 2 years. The L3MTO will be available on all NWS Weather Forecast Office (WFO) climate websites. For example, after July 21, 2006, the Salt Lake City WFO climate website (<http://www.weather.gov/climate/index.php?wfo=slc>) will offer the new L3MTO as the first choice under the "Climate Prediction" tab.



**Figure 1a:** Map of Western Colorado sites where the L3MTO is available. The name of the site will be displayed as the mouse moves over the site. The map can be changed to display Eastern Colorado by clicking the arrows to the top right of the map.

The L3MTO is downscaled or translated from the 3-month outlook that NOAA's Climate Prediction Center (CPC) issues on the third Thursday of each month (available at: <http://www.cpc.ncep.noaa.gov/products/predictions/90day/>). See pages 14 and 15 of this summary). The L3MTO features the same information as the national 3-month outlook: outlooks are provided for 3 categories (below, near, and above normal), and for the probability of exceedance. The difference is the L3MTO extracts more spatial detail, and also features additional interpretation information for all product components.

## Development

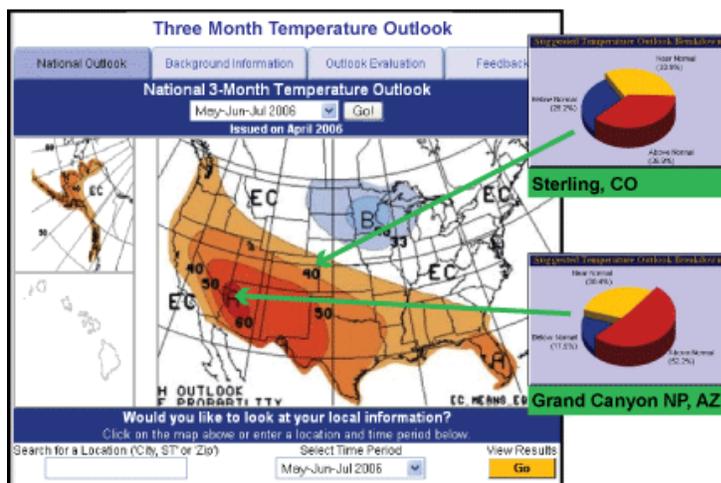
During the L3MTO development, the process was scrutinized by numerous NOAA scientists to ensure the product is scientifically sound and customer friendly. A scientifically sound product includes using a reliable data source, the

simplest forecasting procedure, independent data in forecast tests, and sufficiently testing the forecast process. A customer friendly product is designed with customer input and includes a variety of output components to accommodate a wide range of user needs. As the outlook evolves with time, continuous customer feedback will be important, to make the product as useful as possible.

The first developmental step of the L3MTO was to obtain and test the data for both the climate divisions and local stations, to ensure reliability. A simple linear regression analysis was used for downscaling station temperature from the temperature of the climate division that the station resides in. A number of stations exhibited a significant trend in the difference in temperatures at stations and climate divisions in the most recent years. In these instances, the regression parameters were adjusted to account for this trend; provided that the station-climate division relationship demonstrated sufficient strength (correlation of 0.5 or greater). Splus software computes the L3MTO and generates an enormous volume of output that is then assembled and uploaded to the internet as the final product.

## L3MTO Product Details

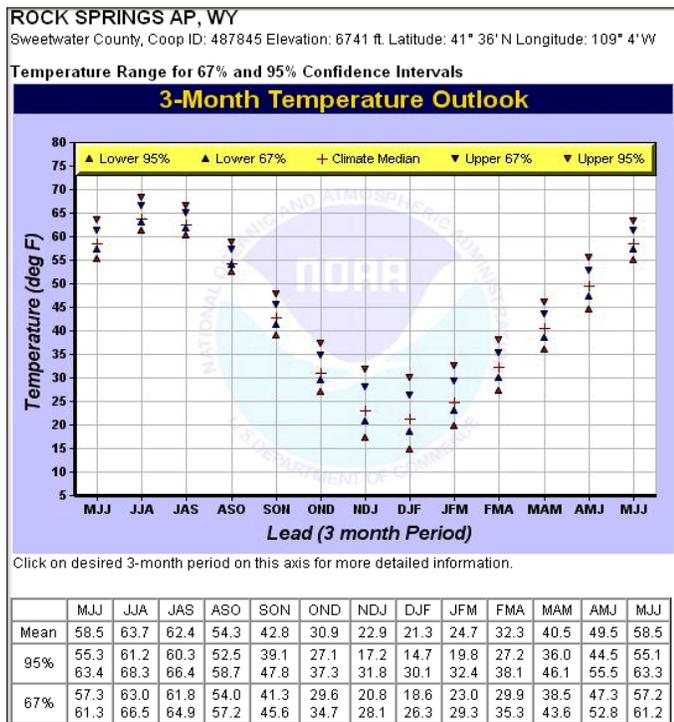
Initially there will be approximately 1150 L3MTO locations available when the product debuts in late July, however this could



**Figure 1b:** CPC 3-month temperature outlook and 2 specific locations where the new L3MTO is available. Notice the L3MTO provides not only the most likely category, but also the probability for the other two categories to occur. The national 3-month temperature shows only the most likely category.

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**Figure 1c:** The average temperature outlook for the Rock Springs Airport, WY (issued in April 2006), indicates that during July, August, & Sept. 2006:

- There is a 67% chance that the seasonal temperature will be within the range of 61.8 and 64.9 Deg F, and a 95% chance that the temperature will be greater than 60.3 and less than 66.4 Deg F.
- There is a greater chance (72.6%) that the temperature will be above the climatological median\* of 62.4 Deg F, and a lesser chance (27.4%) that the temperature will be below the climatological median\*.

\*For the climatological reference information, the median statistic is reported. The median value means that during the present climatological reference period (1971-2000), the temperature in half of the years (50%) was greater than the median and in the other half (50%) less than.

increase to approximately 4,000 sites, depending upon user requirements. The product’s web interface will include clickable maps and text options to help navigate from one location to another. For example, Figure 1a displays all locations in western Colorado where the L3MTO is available. Users have the option of an arrow feature or a text pull down menu to move within and in-between states.

While CPC’s national 3-month outlook (Figure 1b) allows users to gain a quick “at-a-glance” overview of the entire country, it does not provide enough detail to be useful at the local level. The L3MTO is available in several different product components to meet the needs of a variety of users. The simplest product component, in the form of a pie chart, depicts the most likely category, as well as the probability for the other two categories to occur, while the national outlook only provides the most likely category. A simple text interpretation accompanies the pie chart to help explain the outlook.

The second product component of the L3MTO is a temperature range graph (Figure 1c), which displays all 3-month periods for an entire year. The climatological median is plotted and positioned between intervals of 67% confidence and 95% confidence. Interpretive text is also available by clicking in the confidence interval for any one of the 3-month periods.

The L3MTO product suite also includes a Probability of Exceedance component that provides information on the expected

chance for a certain temperature to be exceeded during a particular 3-month period (Figure 1d). The Probability of Exceedance comes in the form of a chart or a table, with the chart also displaying the observed 3-month temperature for the previous 5 years, for comparison.

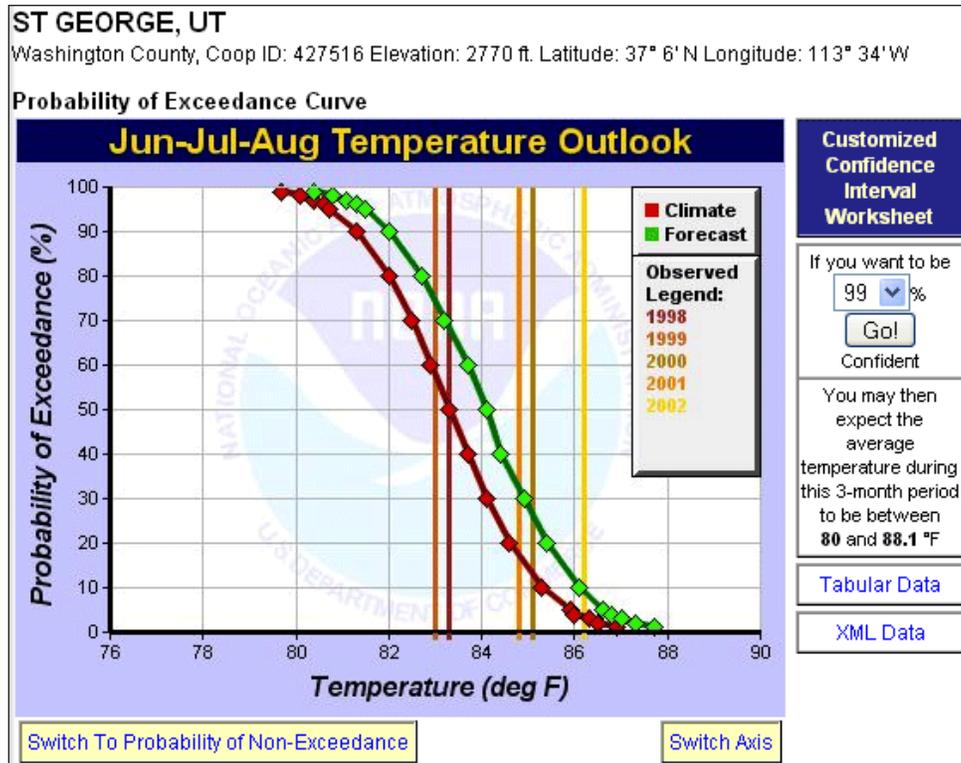
**Limitations and Verification**

As with all long term outlooks and forecasts, limitations exist with the L3MTO. For example, the L3MTO is unable to provide a high confidence outlook for an exact 3 month temperature value or a departure from that value; the product is in probabilistic format. To help users determine the value of the outlook, information on the outlook’s skill (verification) is available. To help the user assess the skill of the L3MTO, every product component includes a link to the Forecast Verification Tool developed by the Climate Assessment of the Southwest (CLIMAS) at the University of Arizona, and expanded to include local climate outlook hindcast information and requirements. The outlook hindcast information is available from December 1994 to 2003. The requirements included a selection of forecast target seasons and specific years for computation of verification statistics. A customer feedback mechanism, tutorials, and helpful text to guide user interpretation, are also included. (See the feature article in the January 2006 Intermountain West Climate Summary for more information on the Forecast Verification Tool.)



**More Local Products To Come**

The Local 3-Month Temperature Outlook is the first local climate prediction product available on WFO climate webpages. The next local outlook product scheduled for release in the summer 2007 is the 3-Month Outlook of Local El Nino/La Nina Impacts on temperature and precipitation. A downscaled Local 3-Month Precipitation Outlook (L3MPO) is currently under development, with a debut targeted for early 2008. Eventually additional meteorological parameters will be added. More up-to-date information will be provided as the implementation date of each of the new local climate products approaches.



**Figure 1d:** Above is the Probability of Exceedance curve for St. George, UT during the 3-month period of June, July, and August 2006. The Probability of non-Exceedance and the Probability of Exceedance with the axis switched can also be displayed.

**On the Web**

- For more information about NOAA/NWS climate products visit: <http://www.cpc.ncep.noaa.gov/products>.



# Temperature through 4/30/06 Source: High Plains Regional Climate Center

Temperatures for the Intermountain West region for April 2006 were above average by 0 to 8° F, with temperatures ranging from average lows in the 30s in western **Wyoming** and north central **Colorado** mountains to 50° F to 60° F in portions of southeastern **Utah** and **Colorado** (Figure 2a-b). Temperatures in **Colorado** had the highest departure from average, with some areas of central and southeast **Colorado** recording temperatures of 6° F to 8° F above average. **Wyoming** was above average by 2° to 6° F and all of **Utah** was also above average by 2° to 4° F, with temperatures in eastern **Utah** nearest average. Temperatures are expected to remain above average, with high streamflow from snowmelt runoff expected again in northern **Utah**.

In comparison to April 2005 (Figure 2c) temperatures were, on average, higher for the entire Intermountain West Region for 2006 with the greatest difference in **Colorado**.

## 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>.

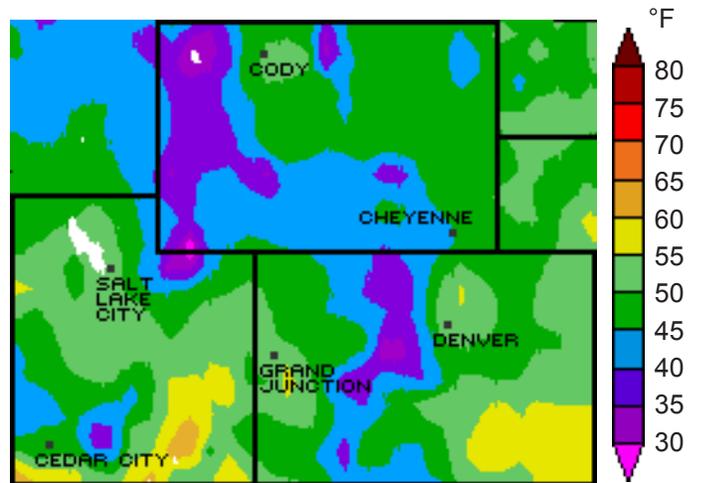


Figure 2a. Average temperature for the month of April 2006 in °F.

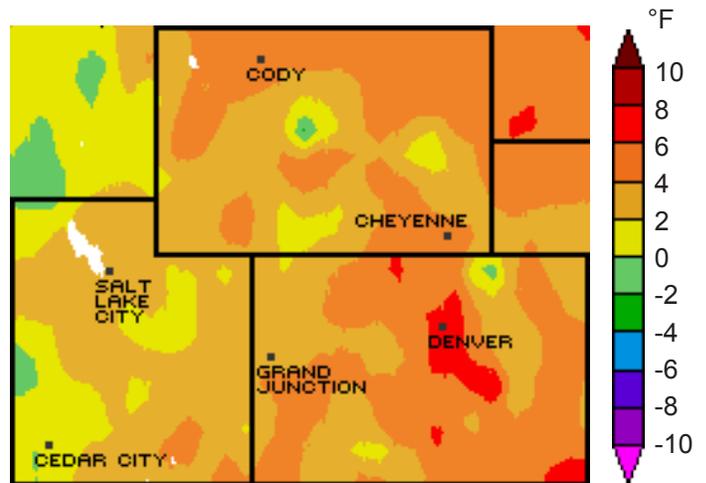


Figure 2b. Departure from average temperature for the month of April 2006 in °F.

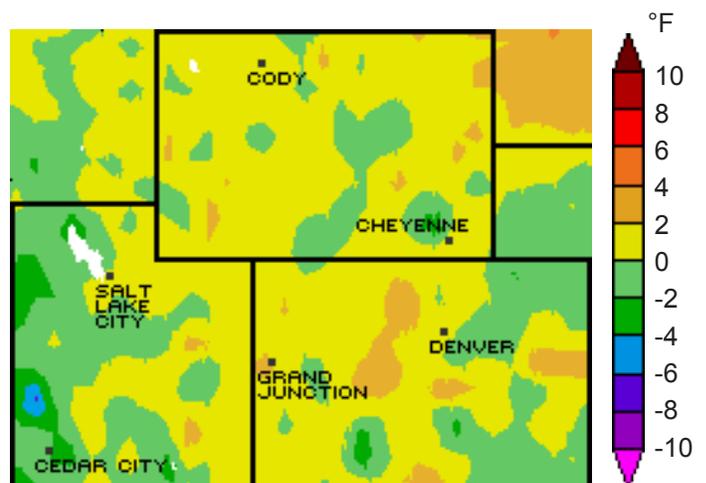


Figure 2c. Departure from average temperature in °F for last year, April 2005.



**Precipitation through 4/30/06** Source: NOAA/ESRL/PSD Climate Diagnostics Branch, NOAA Climate Prediction Center

Precipitation in the Intermountain West region falls primarily as snow in the higher elevations in April and either rain or snow at lower elevation, depending on temperature. While this page displays precipitation totals that include both rain and snow, the snowpack levels on page 7 only reflect the snow water equivalent (SWE).

In April, precipitation totals in the Intermountain West region ranged from 0.25 to +3 inches (Figure 3a). While the mountainous areas of northwestern **Utah**, north central **Colorado** and northwest and south central **Wyoming** received the most precipitation in April (SWE), the eastern plains of **Colorado** and **Utah** received only up to .25 inches.

Precipitation totals for **Wyoming** and **Colorado** were mostly below average in April. Large portions of both states only received 40% to 80% of average precipitation, with nearly the entire eastern half of **Colorado** at greater than 40% of average. **Utah** received average to above average precipitation for April with the northwest mountains receiving 150% to 200% of average precipitation, but the eastern half of **Utah** only received 40% to 60% of average (Figure 3b).

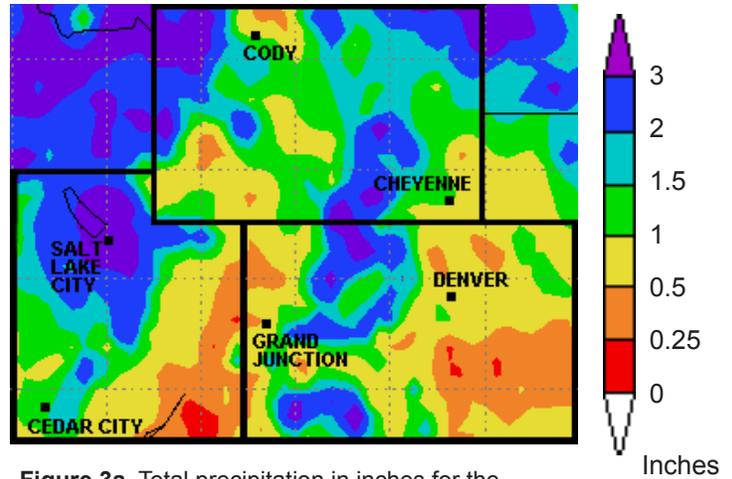
The percent of average precipitation since the start of water year 2005 (Figure 3c) reflects the anomalously high snow-fall levels in northwest **Utah** and anomalously low snowfall levels in central **Wyoming** and southeast **Colorado** this winter.

**Notes**

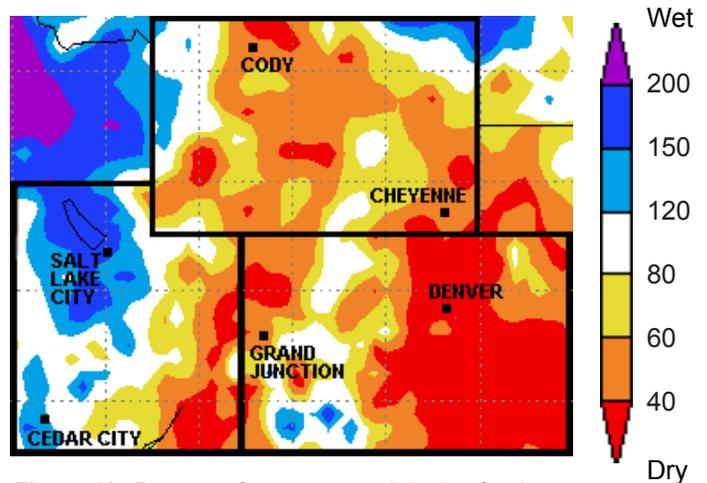
The water year runs from October 1 to September 30 of the following year. As of October 1, 2005, we are in the 2006 water year. The water year is more representative of climate and hydrological activity than the standard calendar year. It reflects the natural cycle of accumulation of snow in the winter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

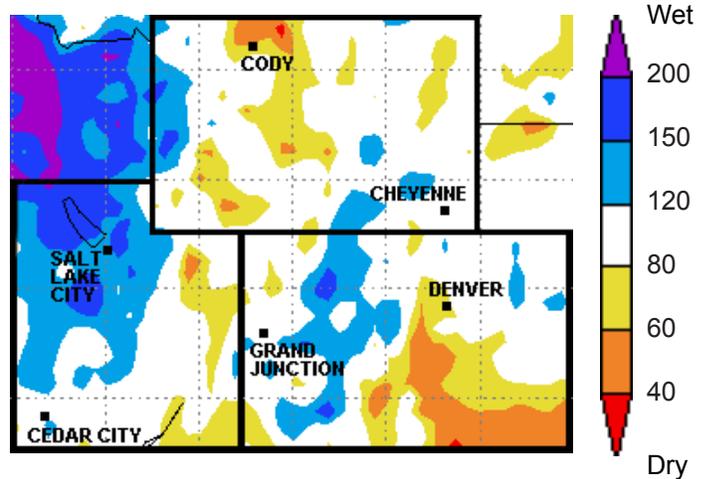
The data in Figs. 3a-c come from NOAA's Climate Prediction Center. The maps are created by NOAA's Climate Diagnostics Center, and are updated daily (see website below). These maps are derived by taking measurements at individual meteorological stations and interpolating (estimating) values between known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



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



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



**Figure 3c.** Percent of average precipitation accumulated since the start of water year 2006. (Oct. 1 - Apr. 30, 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://wf.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 5/16/06

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

As of May 16th, areas of the Intermountain West designated as in drought status remain relatively unchanged since February, but the intensity of drought has increased in eastern **Colorado** and the central high plains, including western Nebraska and Kansas. According to the Drought Monitor, April through June is normally the wettest time of the year for the central High Plains, and non-irrigated crops and pastures depend upon this precipitation. April 2006, however, was abnormally dry in these areas, and May so far has also been dry. Scattered showers dropped 0.2-0.6" of rain on southeastern **Colorado**, but little or no rain fell farther north. In eastern **Colorado**, 60-day precipitation has been only about half of normal (1-2"). Ac-

ording to USDA/NASS, **Colorado** topsoil and subsoil moisture was rated 66% and 79% short or very short, respectively, while winter wheat conditions were 37% poor or very poor. **Colorado** pasture and range conditions were similarly affected, rated 48% poor or very poor. As a result, severe drought (D2) expanded into northeastern **Colorado** and southwestern Nebraska. With a sudden one-month drop in the basin's snow water content (109% to 69%) due to a warm and dry April, state engineers recently shut off 400 wells in northeastern **Colorado**, threatening newly-planted crops. In northern and southeastern **Wyoming**, scattered showers (0.2-1.0 inches) maintained the status-quo.

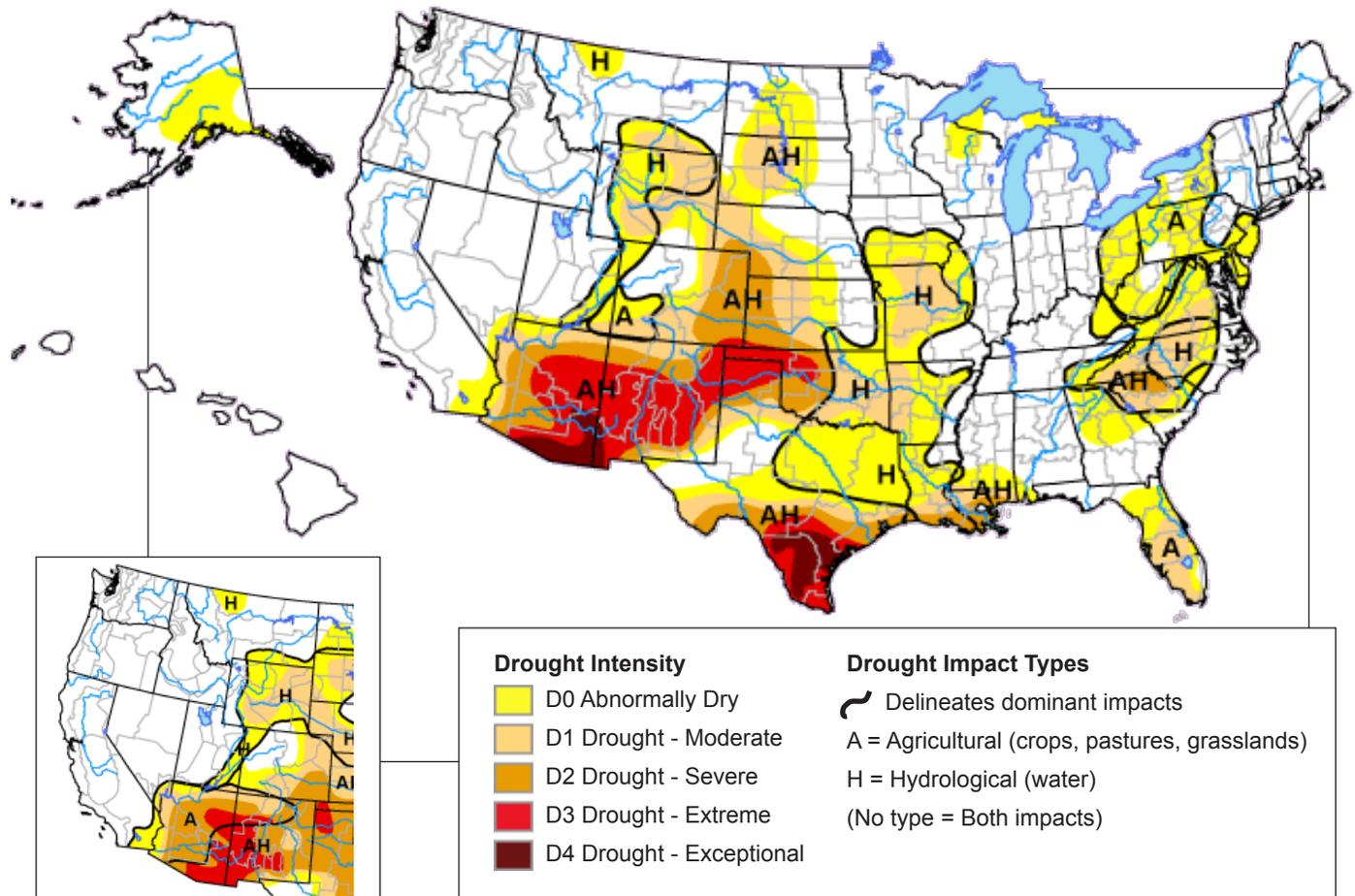


Figure 4. Drought Monitor released May 18, 2006 (full size) and last month April 20, 2006 (inset, lower left) for comparison.

## 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 5/1/06

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

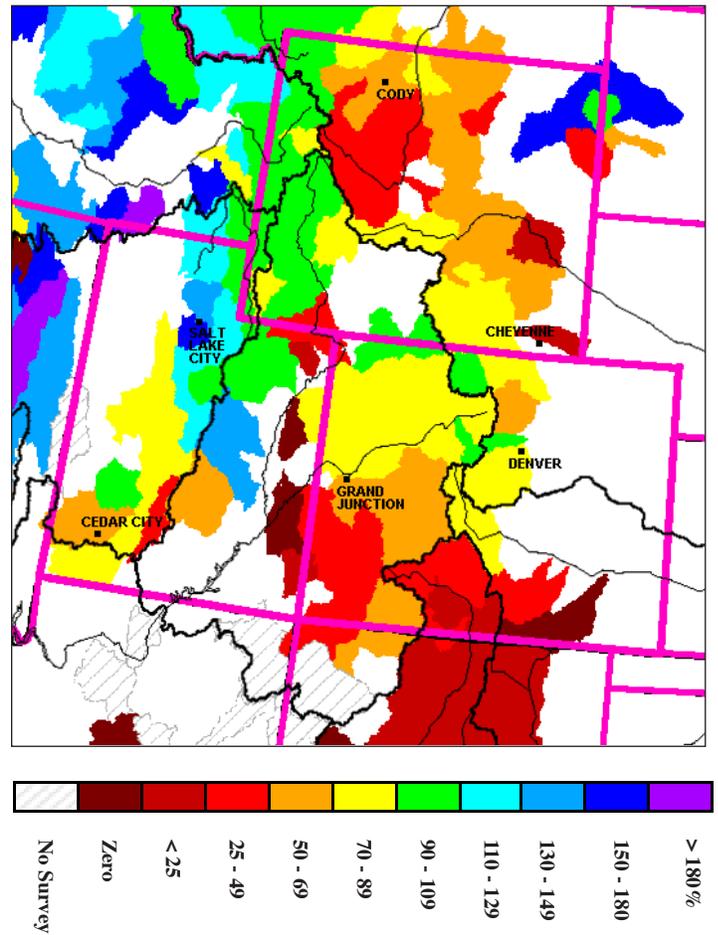
In general, the Intermountain West Region saw a decrease in snowpack as a percent of average during the month of April (Figure 5). Most of **Colorado** now has 70% of average or lower snowpack. The southern part of the state continues to have the lowest snowpack with large areas below 25% in the Rio Grande, Arkansas, and Dolores/San Miguel/Animas basins.

**Wyoming's** snowpack percentages are slightly higher than in **Colorado**. The Belle Fourche basin in the northeast increased to above 105% of average snowpack. The snowpack in the rest of the state ranges from 109% to 25% of average. The highest snowpacks are in the west, in the Green River basin, and the lowest snowpacks are in the central (headwaters of the Powder and Wind Rivers) and several eastern basins (Lower North Platte and Laramie).

The snowpack in **Utah** ranges from 150% to 189% of average in the north-central mountains to 0 in the southeast. The snowpack in the south-central mountains (Sevier River basin) decreased in April from around 100% of average to 50% to 89% of average as of May 1. The snowpack in the south-eastern mountains of the Moab River basin also decreased last month from 50% to 89% of average to 0 to 25%.

### 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 18 for water supply outlooks.)



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

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](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](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>.



# Reservoir Status

Source: Denver Water, U. S. Bureau of Reclamation, Northern Colorado Water Conservancy District, Natural Resources Conservation Service, and Central Utah Water Conservancy District

Usually reservoirs are at their low point for the year in April and early May because they have not started collecting spring streamflows yet. This year, however, a warm and dry April in the Intermountain West Region caused snowmelt to start early. So while most reservoirs are far from being full, their storage is over 100% of average for this time of year (Figure 6). All of the **Colorado** reservoirs in Figure 6 have over 100% of average storage for this time of year, but other reservoirs in the Arkansas and Rio Grande basins are only at 60% to 66% of average, according to the Colorado NRCS. The Gunnison basin has the highest storage in the state, and that is evident in Figure 6 with Blue Mesa Reservoir at 149% of average storage.

In **Utah**, high snowmelt in April in the northern and central mountains lead to above average reservoir storage for Strawberry Reservoir and Utah Lake. According to the Utah NRCS, the state's reservoir storage is 20% higher than it was last year at this time. Lake Powell is holding 11% more of its capacity than it was last year in May. Bear Lake is the only reservoir that is still low from the drought, but

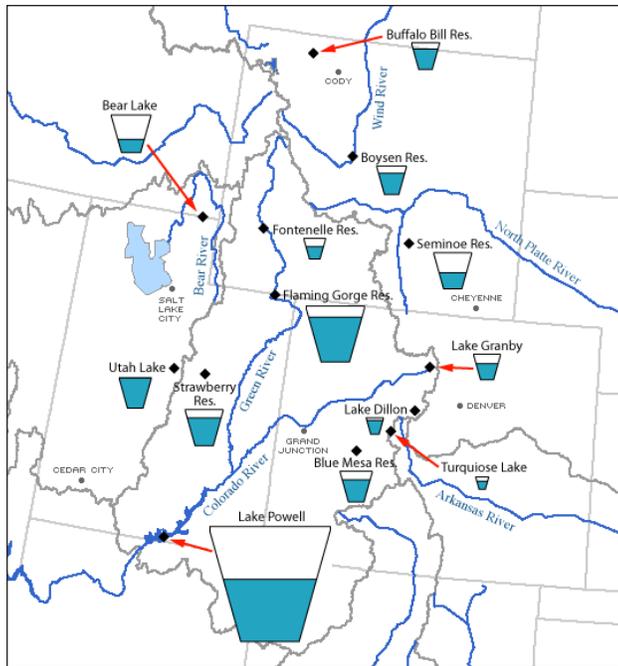
NRCS forecasters feel that the basin will have good streamflows this year.

According to the Wyoming NRCS, the state's reservoir storage ranges from 39% to 168% of average as of May 1. The Green River basin has the highest reservoir storage, with both Flaming Gorge and Fontenelle Reservoirs over 110% of average storage. The storage in the Wind and Powder River basins is slightly below average, but both reservoirs in Figure 6 (Boysen and Buffalo Bill) are above average. The storage in the North Platte basins in the southeast is the lowest in the state, and that is shown in Figure 6 with the Seminole reservoir at 84% of average.

## Notes

The size of each "tea-cup" in Figure 6 is proportional to the size of the reservoir, as is the amount the tea-cup is filled. The first percentage shown in the table is the current contents divided by the total capacity. The second percentage shown is the percent of average water in the reservoir for this time of year. Reservoir statuses are updated at different times, so for the most recent information, see the websites listed in the "On the Web" box.

The percent of average is the current storage divided by the average storage for that day, going back to when the specific reservoir started filling. Averages with (\*) were hand calculated by using raw data from the USBR, whereas the other averages were calculated by the organization that keeps the data for those reservoirs.



**Figure 6.** Tea-cup diagram of several large reservoirs in the Intermountain West Region. All reservoir content data is from between April 30 and May 4, 2006.

Reservoir	Current Water (KAF)	Total Capacity (KAF)	% Full	% of Average
<b>Colorado</b>				
Blue Mesa Res.*	609.0	829.5	73%	149%
Lake Dillon	227.7	254.0	90%	108%
Lake Granby	319.6	539.7	59%	110%
Turquoise Lake	81.8	129.4	63%	115%
<b>Utah</b>				
Bear Lake	391.9	1,302.0	30%	52%
Lake Powell*	11,175.4	24,322.0	46%	72%
Strawberry Res.	856.7	1,106.5	77%	129%
Utah Lake	946.0	870.9	109%	108%
<b>Wyoming</b>				
Boysen Res.	542.1	741.6	73%	112%
Buffalo Bill Res.	469.4	644.1	73%	165%
Flaming Gorge Res.*	3,039.0	3,749.0	81%	81%
Fontenelle Res.*	166.1	344.8	48%	48%
Seminole Res.	408.274	1,017.3	40%	40%

KAF = Thousands of Acre Feet

## On the Web

- Lake Dillon, operated by Denver Water: <http://www.water.denver.co.gov/indexmain.html>.
- Turquoise Lake, Boysen Reservoir, Seminole Reservoir, and Buffalo Bill Reservoir operated by the U.S. Bureau of Reclamation (USBR) Great Plains Region: [http://www.usbr.gov/gp/hydromet/teacup\\_form.cfm](http://www.usbr.gov/gp/hydromet/teacup_form.cfm).
- Lake Granby is part of the Colorado-Big Thompson project, operated by Northern Colorado Water Conservancy District and the USBR Great Plains Region: [http://www.ncwcd.org/dataareports/data\\_reports/cbt\\_wir.pdf](http://www.ncwcd.org/dataareports/data_reports/cbt_wir.pdf).
- Blue Mesa Reservoir, Lake Powell, Flaming Gorge Reservoir, and Fontenelle Reservoir operated by the USBR – Upper Colorado Region: [http://www.usbr.gov/uc/wcao/water/basin/tc\\_cr.html](http://www.usbr.gov/uc/wcao/water/basin/tc_cr.html).
- Strawberry Reservoir, operated by the Central Utah Water Conservancy District: <http://www.cuwcd.com/operations/currentdata.htm>.
- Utah Lake, operated by the Utah Division of Water Rights, and Bear Lake, operated by Utah Power: [http://www.wcc.nrcs.usda.gov/cgibin/resv\\_rpt.pl?state=utah](http://www.wcc.nrcs.usda.gov/cgibin/resv_rpt.pl?state=utah)



## Regional Standardized Precipitation Index data through 4/30/06

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 April 2006, the SPI around the Intermountain West region ranges from very dry in southeastern **Colorado** to very wet in northern **Utah** and **Wyoming** (Figure 7). As opposed to March, when several climate divisions moved into wetter categories, in April several moved into drier categories. The following climate divisions moved into one-drier SPI category in April: Rio Grande, Arkansas, and South Platte divisions in **Colorado**; Lower Platte, Cheyenne & Niobrara, Big Horn, and Yellowstone divisions in **Wyoming**; south central, western, north central, and northern mountains divisions in **Utah**. According to the NRCS, spring runoff increases soil moisture levels and this has already begun in **Utah**. In **Colorado**, they are waiting for spring storms to increase soil moisture.

### 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.

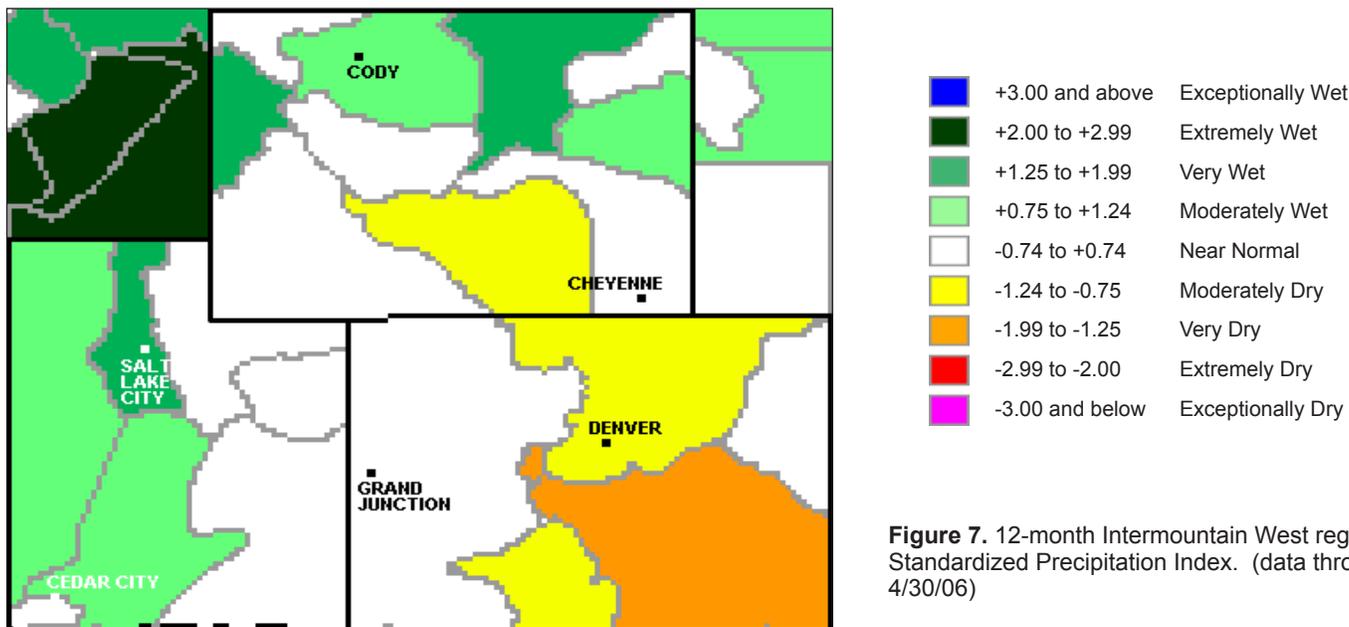


Figure 7. 12-month Intermountain West regional Standardized Precipitation Index. (data through 4/30/06)

### 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>.

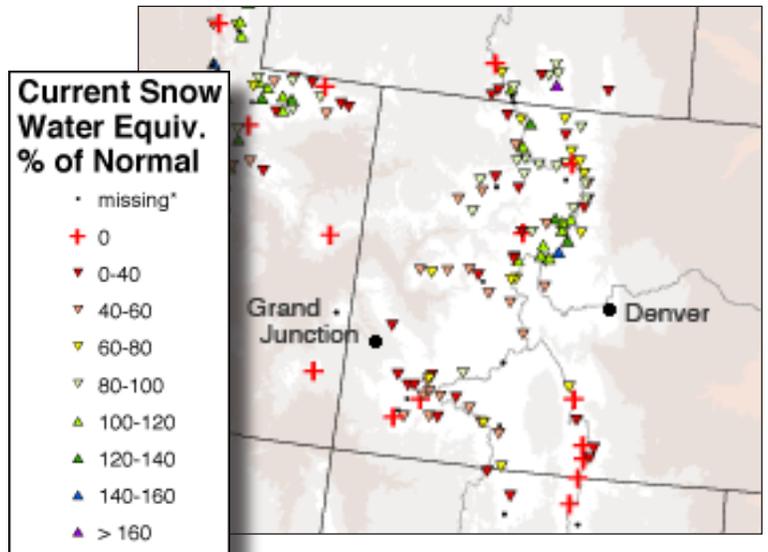


# Colorado Water Availability May 2006

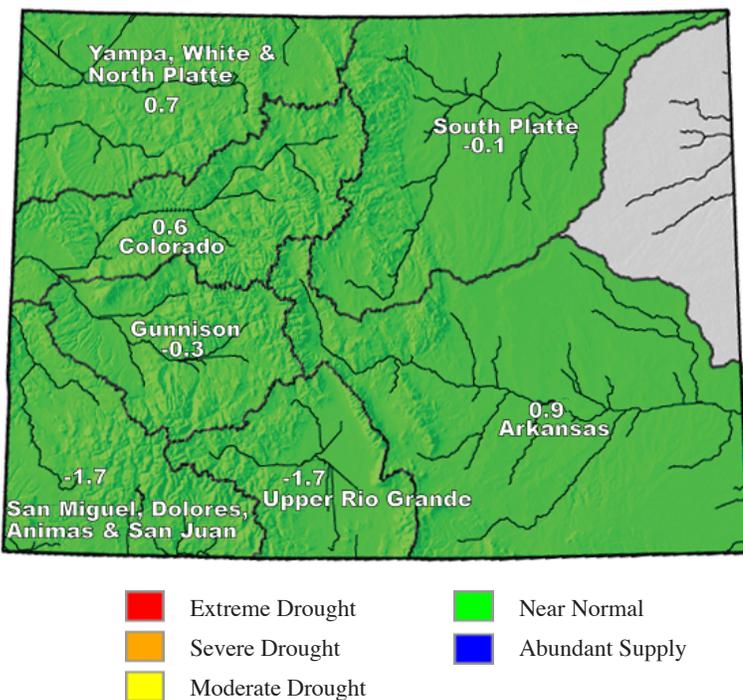
Source: USDA Natural Resources Conservation Service

April was warm and dry in the Colorado mountains, so the snowpack went into an early and rapid melt, according to the NRCS. Therefore, snowpack levels declined across the state. Figure 8a, which shows the SWE as a percent of average, is much lower than last month with most sites below 60% of average. Some sites in the north-central mountains in the South Platte basin are still above average.

According to the May Surface Water Supply Index (SWSI) (Figure 8b) the whole state remains in the near normal category, but all the SWSI numbers have decreased since last month. The only basins that are still above zero are the Colorado and the Yampa/White/North Platte. According to the NRCS, these are also the only basins that can expect above average streamflows this spring and summer.



**Figure 8a.** Current snow water equivalent (SWE) as a percent of normal for SNOTEL sites in Colorado as of May 2, 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 8a shows the SWE as a percent of normal (average) for SNOTEL sites in Colorado. Figure 8b 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 8b were computed for each of the seven major basins in Colorado for May, 2006, and reflect conditions through the month of April 2006.

**Figure 8b.** 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 May 2, 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](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](http://www.co.nrcs.usda.gov/snow/snow/snow_all.html) and click on "Basin Outlook Reports."

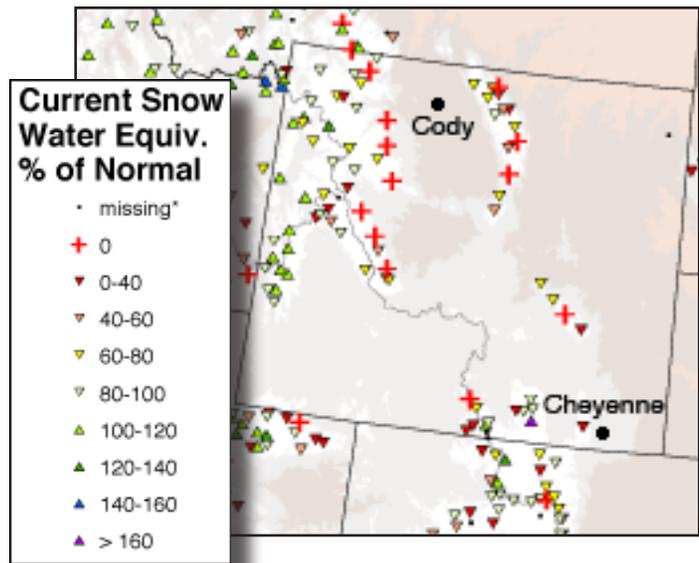


# Wyoming Water Availability May 2006

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

Wyoming continues to have more snowpack in the Green and Upper Snake River basins in the west than in the rest of the state (Figure 9a). The warm and dry April affected the Wyoming snowpack and many stations in the central mountains are reporting zero snow as of May 1. The NRCS is reporting that the state has an average of 81% of average SWE, with the lowest SWE in the northwest (58% of average) and the highest in the southwest (90% of average).

The Surface Water Supply Index (SWSI) values show similar patterns of spatial distribution to the snowpack map (Figure 8b). Like Colorado, the SWSI numbers decrease for all basins during April. The driest basins are the Wind, Powder and Big Horn River basins, which are in the moderate drought categories. The Lower North Platte and Laramie River basins are also below zero, in the mild drought category.



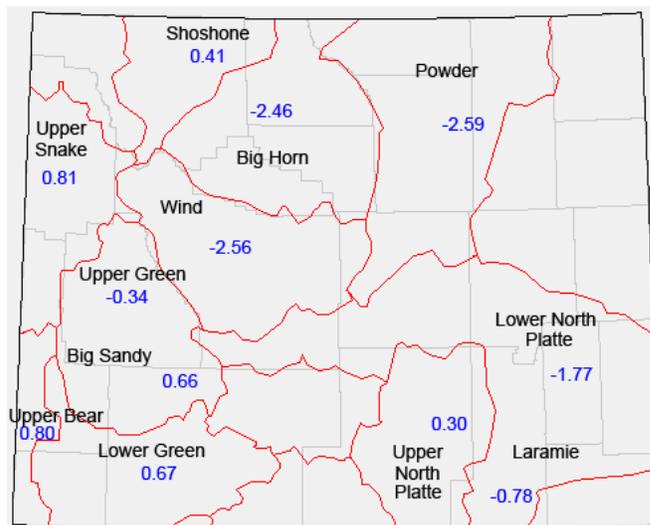
**Figure 9a.** Current snow water equivalent (SWE) as a percent of normal for SNOTEL sites in Wyoming as of May 2, 2006. **This is provisional data.** For current SNOTEL data and plots of specific sites, see <http://www.wcc.nrcs.usda.gov/snow/>.

## Notes

Figure 9a 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 9b.** 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](http://www.drought.noaa.gov).
- For current streamflow information from USGS, visit: <http://water.usgs.gov/waterwatch/>
- 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>.

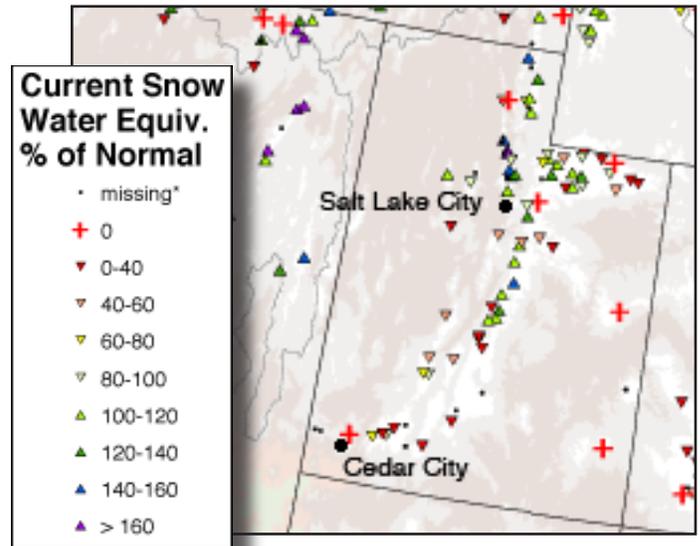


# Utah Water Availability April 2006

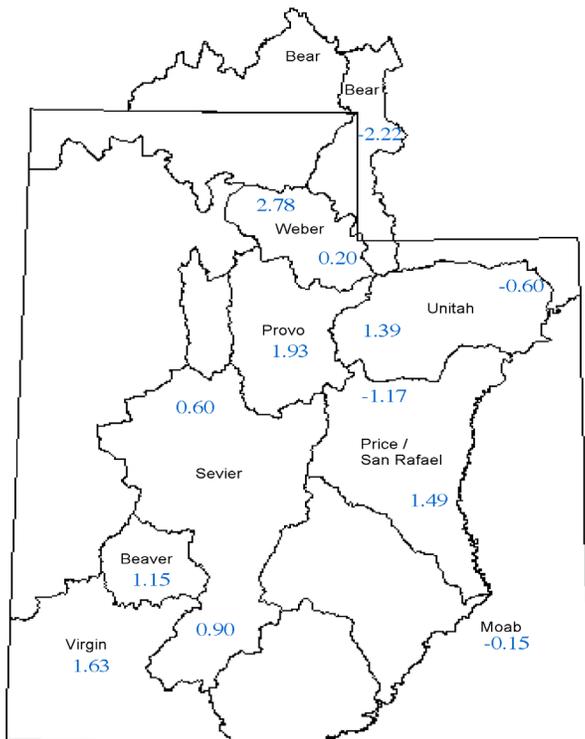
Source: USDA Natural Resources Conservation Service and the Colorado Basin River Forecast Center

Utah was dry and warm in April, like in Colorado and Wyoming. According to the NRCS, the snowmelt runoff was a positive thing for the northern mountains, but not the southern mountains. In the north, where they were concerned with high spring runoff, the early melt lessened some fears of flooding. On the other hand, in the south where snowpacks have been below average all winter, the early melt was disappointing because they could use more snowfall. Figure 10a shows a range of snowpack as a percent of average, with some southern stations reporting 0 to 40% and some northern stations reporting 140% to 160% of average.

The Utah Surface Water Supply Index (SWSI) (Figure 10b) shows a similar pattern to the SNOTEL sites, with more water available in the north and less in the south. However, while most SWSI numbers decreased since April 1, both the Beaver and Moab River basins increased slightly. The basins with the greatest decreases are in the central part of the state, the Weber, East Uintah and Price River basins.



**Figure 10a.** Current snow water equivalent (SWE) as a percent of normal for SNOTEL sites in Utah as of May 2, 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 10b.** Utah Surface Water Supply Index (data through 5/1/06).

- Key:
- 4.1 Abundant Supply
  - 0 Water Supply Comparable to Historical Average
  - +4.1 Extremely Dry

## Notes

Figure 10a 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 10b) 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 10 for the SPI.

## 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](http://www.drought.noaa.gov)
- For current streamflow information from USGS, visit: <http://water.usgs.gov/waterwatch/>



# Temperature Outlook June - October 2006

Source: NOAA Climate Prediction Center

The temperature outlook issued on May 18th has not changed appreciably since the April 2006 forecasts. According to the NOAA Climate Prediction Center, a large area of the southern and western U.S., including **Utah, Colorado,** and southern **Wyoming,** has an increased risk of above average temperatures in June 2006 (Figure 10a). Above average temperatures are likely through the summer for all or most of the Intermountain West for through the summer (Figure 10b-d). This forecast means that the average for the month, or the average for the three month season is more likely to be above the climatological average for the 1971-2000 time period.

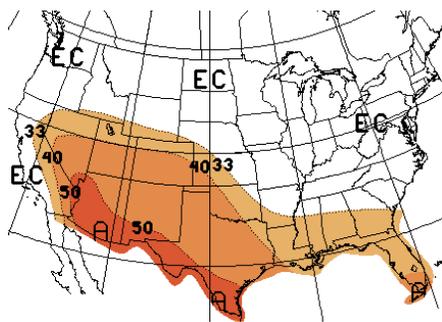
The forecast for May 2006 will be updated on May 31st. Last year, CPC began updating its forecast for the next month on the last day of the previous month. This “zero-lead” forecast often can take advantage of long-lead weather forecasts and typically has increased skill over the forecast made mid month because of the shorter lead time. This forecast is available on the same CPC webpages as the regular mid-month forecasts.

## Notes

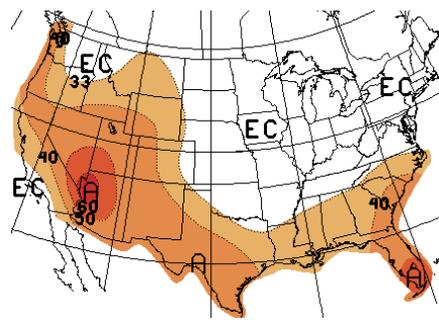
The seasonal temperature outlooks in Figures 10a-d predict the likelihood (chance) of *above-average*, *near-average*, and *below-average* temperature, but not the magnitude of such variation. The numbers on the maps refer to the percent chance that temperatures will be in one of these three categories,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

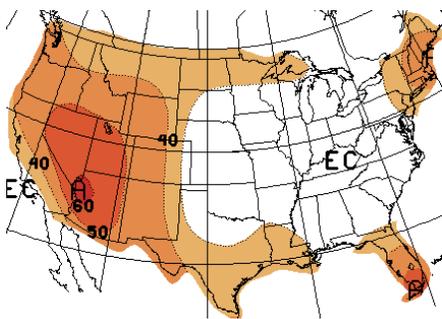
Equal Chances (EC) indicates areas for which the models cannot predict the temperature with any confidence. EC is used as a “default option” representing equal chances or a 33.3% probability for each tercile, indicating areas where the reliability (i.e., ‘skill’) of the forecast is poor.



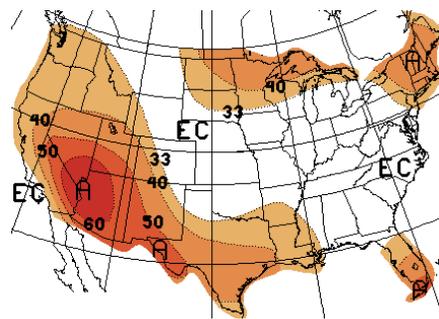
**Figure 11a.** Long-lead national temperature forecast for June 2006. (released May 18, 2006)



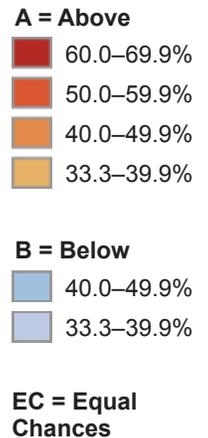
**Figure 11b.** Long-lead national temperature forecast for Jun. - Aug. 2006. (released May 18, 2006)



**Figure 11c.** Long-lead national temperature forecast for Jul. - Sep. 2006. (released May 18, 2006)



**Figure 11d.** Long-lead national temperature forecast for Aug. - Oct. 2006. (released May 18, 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](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/](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 June - October 2006

Source: NOAA Climate Prediction Center

Summer seasonal precipitation forecasts, issued May 18th by the NOAA Climate Prediction Center (CPC), have changed little since the April forecast. The Intermountain West has “equal chances” of above-average, near-normal or below-average precipitation for the June 2006 forecast period (figure 11a) and beyond (Figure 11c-d).

According to CPC, there are no significant skillful indications for June precipitation anomalies from the forecast tools. Large-scale soil moisture conditions can have a significant impact on precipitation in this time of year in some areas of the country, and the soil moisture tools show some potential for dry conditions in portions of the desert southwest. However there is little if any skill in prediction of below normal precipitation in the normally dry southwest prior to the monsoon onset.

The June precipitation forecast will be updated in on May 31th and may provide more forecast information. Last year, CPC began updating the 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.

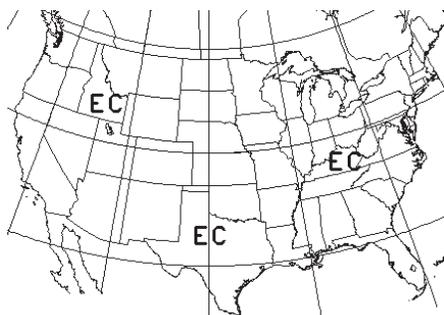
## Notes

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.

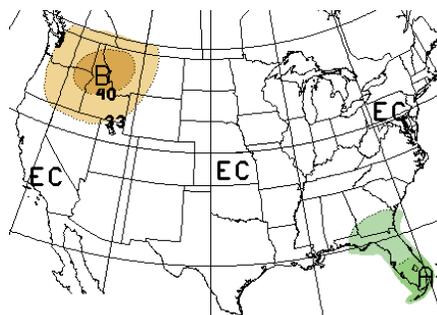
The NOAA-CPC outlooks are a 3-category forecast based largely on the status of El Niño and recent trends. As a starting point, the 1971-2000 climate record for each particular 1 or 3 month period is divided into 3 categories or terciles, each with a 33.3% chance of occurring. The middle tercile is considered 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 chances of above average precipitation.

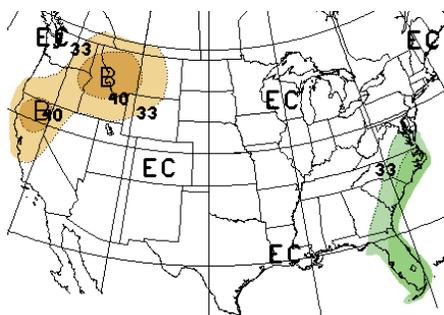
Equal Chances (EC) indicates areas for which the models cannot predict the precipitation with any confidence. EC is used as a “default option” representing equal chances or a 33.3% probability for each tercile, indicating areas where the reliability (i.e., ‘skill’) of the forecast is poor.



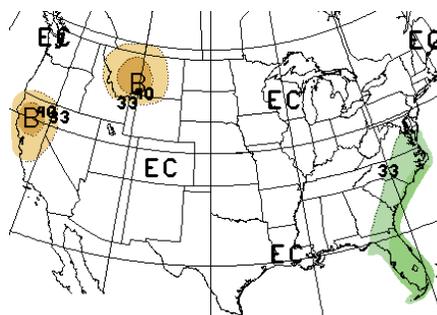
**Figure 12a.** Long-lead national precipitation forecast for June 2006. (released May 18, 2006)



**Figure 12b.** Long-lead national precipitation forecast for Jun. - Aug. 2006. (released May 18, 2006)



**Figure 12c.** Long-lead national precipitation forecast for Jul. - Sep. 2006. (released May 18, 2006)



**Figure 12d.** Long-lead national precipitation forecast for Aug. - Oct. 2006. (released May 18, 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](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/](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 August 2006 Source: NOAA Climate Prediction Center

Drought is likely to persist in eastern and southern **Colorado**, central and northeastern **Wyoming** and western Nebraska, and to improve in areas of the Southwest that are influenced by the rains from the upcoming monsoon season. The monsoon typically begins in July over Arizona and New Mexico, but also may bring rain to **Colorado**. The greatest impact of the rains will likely be the reduction of fire danger in July and August.

The Seasonal Drought Outlook is based on the CPC long-lead precipitation outlook for the upcoming season in this case June-August (pp. 14 and 15), drought termination and amelioration probabilities from the NOAA/National Climatic Data Center (see URL below), and various medium and short-range forecasts and models such as the 6-10 day and 8-14 day forecasts, and the soil moisture tools.

## Notes

The delineated areas in the Seasonal Drought Outlook (Figure 13) 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.

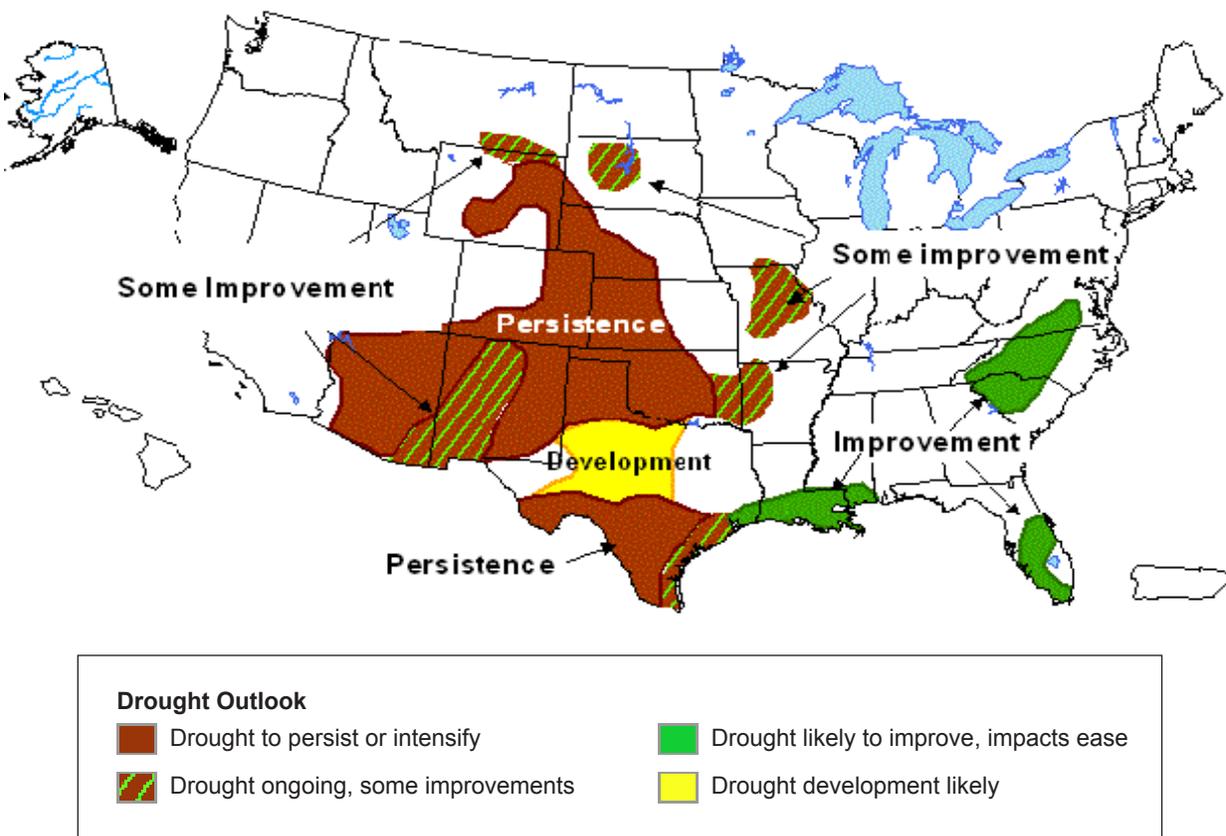


Figure 13. Seasonal Drought Outlook through July 2006 (release date May 18, 2006).

### On the Web

- For more information, visit: <http://www.drought.noaa.gov/>.
- Drought termination probabilities: <http://www.ncdc.noaa.gov/oa/climate/research/drought/current.html>



# 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), ENSO-neutral conditions are expected to prevail during the next 3-6 months. During April SSTs were close to average at most locations between Indonesia and 90°W (near the coast of Ecuador), and as of mid-May SSTs are within 0.5°C of average across the equatorial Pacific. There are some last remaining vestiges of La Niña in the atmospheric circulation in the western tropical Pacific, these patterns are expected to continue to decline in strength. No impacts from ENSO on the North American region – including the Intermountain West -- are anticipated through the summer.

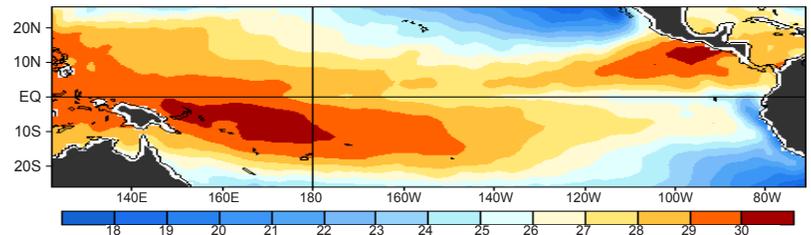
Although La Niña conditions persist in some models (Figure 14b), CPC's prognostic discussion for long-lead seasonal outlooks forecast, issued May 18, 2006, says that ENSO-neutral conditions are the most likely for most of the rest of the year. According to the IRI, there is about a 90% probability that ENSO-neutral conditions will continue through the May-June-July period; the chances of an El Niño developing through the fall (the September-November period) are about 25%, and about a 10% chance that a La Niña may occur in that period. Historically, El Niño and La Niña events tend to develop in the April-June period, and they reach their maximum strength in December-February.

## Notes

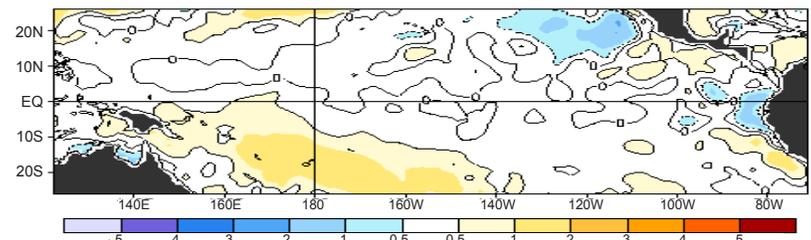
Two graphics in Figure 14a produced by NOAA show the observed SST (upper) and the observed SST anomalies (lower) in the Pacific Ocean. This data is from the TOGA/TAO Array of 70 moored buoys spread out over the Pacific Ocean, centered on the equator. These buoys measure temperature, currents and winds 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 14b 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.

**Observed Sea Surface Temperature (C°)**

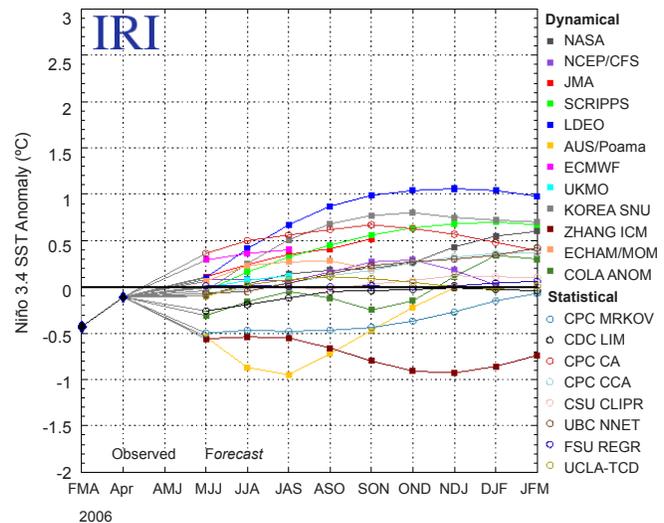


**Observed Sea Surface Temperature Anomalies (C°)**



**Figure 14a.** 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 May 10, 2006.

**Model Forecasts of ENSO from May 2006**



**Figure 14b.** 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 May 2006 through March 2007 (released May 17, 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/](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/>.

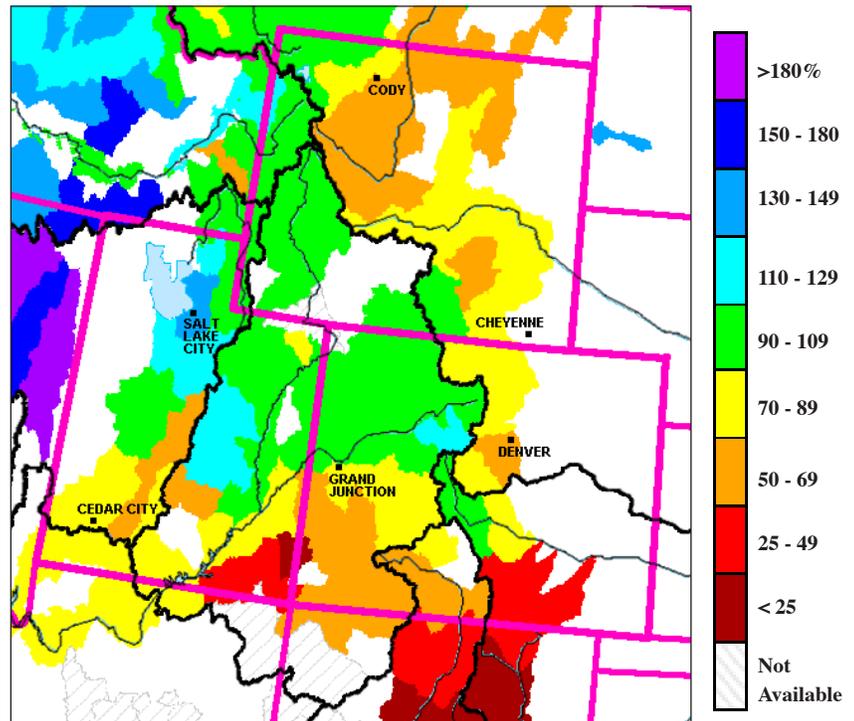


## Water Supply Outlook for the 2006 runoff Season

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 northwestern **Colorado**, southern and western **Wyoming** and most of northern **Utah**. The water supply outlook for the Intermountain West Region as of May 1 (Figure 15) has several areas of decreased streamflow forecasts since last month, due to the dry and warm April. The South Platte basin in northern **Colorado**, most of **Wyoming** east of the Green River basin, and some southern **Utah** basins decreased to 50% to 89% of average streamflows.

According to the Water Supply outlook issued by the Colorado Basin River forecast Center ([www.cbrfc.noaa.gov](http://www.cbrfc.noaa.gov)), there was above normal snowmelt in many areas in April, due to above normal temperatures. April precipitation was also low across the basin, with a few exceptions. As a result, forecasts for streamflows and inflows into reservoirs have dropped from those issued April 1st, and are below average across most of the Colorado River basin. Rio Grande forecasts, issued by the West Gulf River Forecast Center, are also well below average (see RFC webpages below for details).



**Figure 15.** NRCS map showing the expected natural streamflows for spring and summer in the Intermountain West region as a percent of average streamflows. (data through May 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 15 shows the forecasts of natural runoff, based principally on measurements of precipitation, snow water equivalent, and antecedent runoff (influenced 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 Plate): <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/>





## National Weather Service Western Region and its Climate Service Activities

By Keah Schuenemann and Eileen McKim, Western Water Assessment

In the United States, the West is known not only for its extreme land, from the peaks of the Rocky Mountains to the area below sea level in Death Valley, but for its extreme climate. Yearly rainfall totals can reach 100 inches in the mountains of Washington and as little as four inches in the western deserts. Natural events such as blizzards, floods, tsunamis, severe droughts, tornadoes, and extreme heat keep the National Weather Service (NWS) in this region on their toes.

The NWS Western Region (NWSWRH) Headquarters (<http://www.wrh.noaa.gov/>) is located in Salt Lake City, Utah, but the region itself includes the states of Montana, Idaho, Washington, Oregon, California, Nevada, Utah, and Arizona. Within this region there are twenty-four Weather Forecasting Offices, three River Forecasting Centers, and four Center Weather Service Units. Together, they provide weather, hydrological, and climate forecasts and warnings for the region “for the protection of life and property and the enhancement of the national economy,” as their mission statement explains. They also provide their products and raw data to both public and private users.

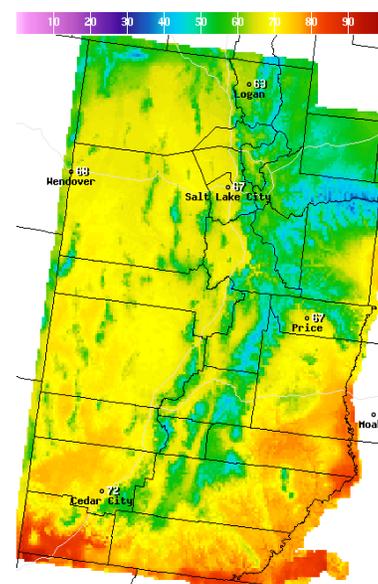
The NWSWRH provides services under three main divisions: Meteorological Services, Scientific Services, and Hydrology and Climate Services. The Meteorological Services Division (MSD) sets requirements, implements, and manages day-to-day programs of weather prediction and warnings in the Region, and weather services provided by all weather service offices located within the Region. MSD is responsible for management of public, aviation, marine, Automated Surface Observation Systems (ASOS), and fire weather forecast programs and for monitoring and evaluating the day-to-day quality of services, predictions, and warnings. Some of the activities of the Scientific Services Division (SSD) include: improving forecast services through introduction of new data sets/experimental model data into operations, improving the knowledge of current conditions in complex terrain through integration of mesonet data and better analysis systems, and developing and implementing new internet and web services. The Hydrology and Climate Services Division (HCSD), concentrates specifically on river forecasts, flood forecasts and warnings, water supply forecasts, and the use of climate prediction products. The programs within the HCSD are the Weather Forecast Office (WFO) and River Forecast Center

hydrology programs, Cooperative Observer program, Surface Observations, and the climate program.

One of the new products available at the NWSWRH website is the NOAA/NWS National Digital Forecast Database (NDFD) Experimental Graphic Forecast Displays (<http://weather.gov/forecasts/graphical/sectors/index.php>). (Figure 1) These graphics are web-based presentations of digital forecast data originating from local (WFO) digital databases and the NDFD server.

The data are displayed in a mosaic form on national and regional scales. By clicking on any point on the regional maps, local forecasts of precipitation, temperature, snow cover, wind speed, sky cover and other variables are displayed.

The NWS Strategic Plan for 2005-2010 was released January 3, 2005 and includes the goals of the National Weather Service for the next 5 years. One of the goals is to include chemical and biological components along with space, ocean, and land processes into the existing weather models. Another goal is to expand the Advanced Hydrologic Prediction Service to include soil moisture and water quality forecasts for fresh water, estuaries, and coastal zones. The climate information will also be expanded by improving predictions of climate and studying past and current climates. These goals will expand and improve the existing hydrologic tools and forecasts throughout the NWS over the next five years.



**Figure 16:** This map is one of the National Oceanic and Atmospheric Administration (NOAA) National Weather Service (NWS) National Digital Forecast Database (NDFD) Experimental Graphic Forecast Displays showing temperature for Utah. These maps display forecasts that are normally updated every hour.

### On the Web

- For more information about NOAA/NWS Western Region, please visit: <http://www.wrh.noaa.gov/>
- For more information on the NDFD, please refer to the NDFD information web site at: <http://www.weather.gov/ndfd/>.

