Intermountain West Climate Summary

by The Western Water Assessment

Issued January 13, 2006

January 2006 Climate Summary

Hydrological Conditions – While the Intermountain Region is largely out of a drought, low snowpack in the southern part of the region could lead to an increase in drought conditions throughout the winter.

Temperature – Although areas in the region experienced both cold and warm periods, temperatures were within 2°F of average for most of the region in December 2005.

Precipitation/Snowpack – Areas experiencing above average precipitation in December 2005 included the north-central mountains of Colorado, the central and western mountains of Wyoming, and north-central Utah.

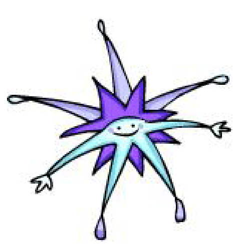
ENSO – A week La Niña is developing and is expected to continue for 3 – 6 months.

Climate Forecasts – The long-term seasonal climate forecasts predict above average temperatures for the next five months in the Intermountain West Region. There are no forecasts for precipitation for our region.

The next IMW Climate Summary will be released in mid-March. In the interim, check the websites provided for the most up-to-date information.

Snow Accumulation Season Is upon Us!

In January, the first outlooks of the water year are available, based on early winter precipitation and snowpack. On the Water Supply Outlooks page, we summarize the first seasonal outlooks of runoff volume. These outlooks are very preliminary at this stage – subject to the accumulation of snowpack through the winter, and to spring and early summer weather. They will be updated by the River Forecast Centers (RFC) and the Natural Resource Conservation Service on the first of the month through the runoff season, and we encourage you to go to the RFC webpages (see page 17) and see the detailed outlooks for the areas that interest you. We have not included a reservoir status page this month because reservoir levels are typically low and slowly decreasing during the winter; that page will return in the spring when the reservoirs begin to fill again. This month we also feature a tool for evaluating forecasts in several ways that may be more meaningful than the Heidke skill scores.



In This Issue

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
Barb DeLuisi - Graphic Designer

Disclaimer - This product is designed for the provision of experimental climate services. While we make every effort to verify this information, please understand that we do not warrant the accuracy of any of these materials. The user assumes the entire risk related to the use of this data. WWA disclaims any and all warranties, whether expressed or implied, including (without limitation) any implied warranties of merchantability or fitness for a particular purpose.

The Intermountain West Climate Summary is published monthly by Western Water Assessment, a joint project of the University of Colorado and the NOAA/Earth System Research Laboratory/, Physical Sciences Division/Climate Diagnostics Center, researching water, climate and societal interactions.

How to use the climate Forecast Evaluation Tool: Web-based method yields quick way to test accuracy of seasonal predictions

By Melanie Lenart of the Climate Assessment of the Southwest (CLIMAS)

(A version of this article first appeared in the November 29, 2005 edition of the Southwest Climate Outlook, a CLIMAS publication, available at: http://www.ispe.arizona.edu/climas/index.shtml)

The article describes a tool for users to evaluate climate forecasts, which may be useful for our readers in the Intermountain West Region.

"I could do better by flipping a coin." If this thought has ever crossed your mind while considering a climate forecast, you can test your theory objectively using the web-based Forecast Evaluation Tool (FET). The tool allows for an on-line examination of the successes and failures of past forecasts by climate division, season, and lead time of the forecast.

The Forecast Evaluation Tool grew under the tutelage of Dr. Holly Hartmann based on interviews she conducted with regional decision-makers for The University of Arizona's Climate Assessment for the Southwest (CLIMAS), a program funded by the National Oceanic and Atmospheric Administration (NOAA). Stakeholders revealed that they were hesitant about basing decisions on seasonal climate forecasts without knowing the track records of the forecasts. Western Water Assessment has seen similar attitudes among water managers in Colorado.

With support from a half-dozen other agencies over the years, Hartmann and her team responded by designing the FET to provide customized comparisons of climate forecasts. Although the website continues to evolve and the tool is still under development—it is considered a "beta-test" version—the FET now can compare all forecasts made since 1994 by the National Weather Service's Climate Prediction Center (CPC), the NOAA branch that issues official government forecasts. Future plans call for similar testing of forecasts issued by other agencies, as well as testing of projections for streamflow (water transport in rivers).

This article serves as a set of easy instructions designed to guide you through the process of using the FET for the first time to check the performance of the CPC climate forecasts you consider most relevant.

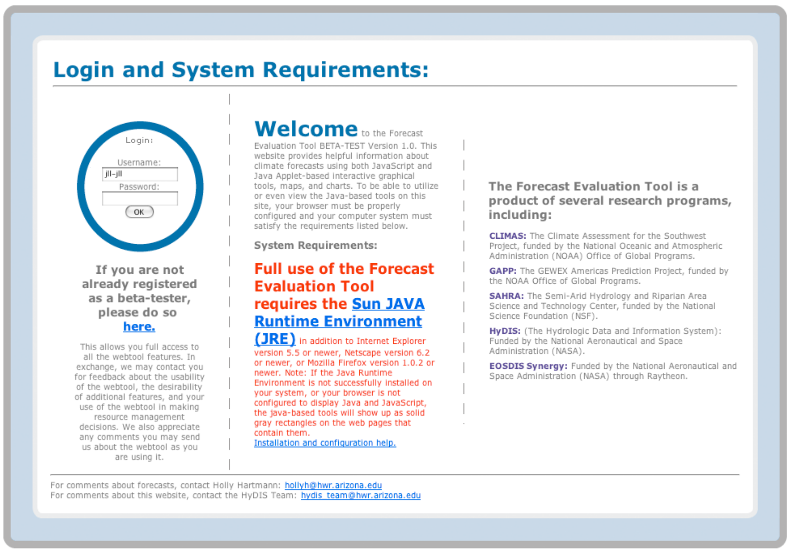


Figure 1a: FET homepage (http://fet.hwr.arizona.edu/ForecastEvaluationTool).

Getting started

Go to the website http://fet.hwr.arizona.edu/ForecastEvaluationTool/ (Figure 1a). Register for the confidential service by providing your name, organization, and email address and choosing a login name and password. After you submit your registration information, you should be able to sign in with no wait. In time, users will have the option to save their evaluation work and other climate information for future reference. Use of the FET is free of charge and registration information will not be shared with any other organization.

Download Java

Many new computers already have Java installed. If yours doesn't, Java offers a free download of the Sun Java Runtime Environment program (237 kilobytes) needed to show the results of the evaluations. You can access a link to the Java website directly from the FET website. Choose the correct program for your system and follow the installation instructions. Once the program is installed, return to the FET website.

Interpreting climate forecasts tutorial

An optional tutorial introduces users to the concepts and terminology of CPC forecasts. For instance, the tutorial brings home the important point that an Equal Chances or "EC" forecast is tantamount to no forecast at all. To make sure you're interpreting CPC forecasts properly, you can take the five-question self-test at the end. As soon as you submit your answers, you'll see your score as well as the correct answers.

Seasonal climate forecasts use a tercile approach. They consider the probability that climate conditions will fall into one of three categories: above-average, near-average, or below-average. Average is relative to actual conditions observed during a 30-year period—from 1971 through 2000.

Each of the 30 baseline seasons (or years) is divided equally into these three categories, with 33 percent labeled above-average, 33 percent called near-average,

(Continued on p. 3)

(Continued from p.2)

and 33 percent considered below-average. For example, a forecast that calls for a 40 percent probability of above-average temperature is less certain than a forecast that calls for a 70 percent probability of above-average temperatures. In both cases the projection is for temperatures to fall into the above-average tercile as compared to the actual conditions observed from 1971 through 2000.

White space on the map indicates Equal Chances (EC) of falling into any of the three terciles (i.e., no forecast). Only rarely does the CPC issue a forecast predicting near-average temperatures, indicated by gray shading.

Climate forecast performance

On the FET home page, you'll also see options to "Explore the Forecasts," to consider "How do the forecasts relate to my specific situation?" and to evaluate "Forecast Performance." Select "Forecast Performance" to follow the example here.

This is where you can test and compare how CPC forecasts have performed in the past, based on the forecasts issued since 1994. Here we take a step-by-step approach to testing a seasonal forecast's success:

1. The "National Weather Service Climate Prediction Center" option is automatically selected, so there's no need to do anything. (In the future, other options will become available.)
2. Select NWS CPC seasonal climate outlooks (contiguous states).
3. Select precipitation.
4. Select a forecast season, in groups of three months, by sliding the shaded box with your cursor and then clicking on it. The months are listed by their first initial only. Choose DJF to get the three-month seasonal outlook for December, January, and February. The selected grouping will show up below the shaded area as DJF. (If you want to do more than one three-month period, click your mouse upon each selection and you'll see the selected months listed below.)
5. Select the month or months during which the forecast was issued. Click in the boxes for each year you want. We'll select N (November) for each available year (1994–2004). The three-month seasonal forecasts are issued up to a year in advance and updated every month.
6. You now have the opportunity to select the type of statistical test you'd like to apply to the forecasts. Select the "False Alarm Rate" option. Brief descriptions of the other options (e.g., Probability of Detection, Brier Score) are included at the end of this article.
7. Once you have made your choices, hit "Submit" to launch the program. When the results appear, read the box at the top under "You Chose" to make sure the computer accurately recognized all your choices. (For example, if you did not click on your season selection, the default "All Seasons" will appear.)
8. The results will include national maps color-coded by division and a color bar below that explains the legend (Figure 1b). For these comparisons, the 344 NOAA climate divisions have been grouped into 102 larger divisions. Colorado Wyoming, and Utah have eleven total divisions under this system, with some divisions that overlap other states. You can see the actual value for a climate division by holding your cursor over it.

Frequency of Forecast Results

Regardless of which category you select, you will first see a map indicating the Frequency of Forecast Results. This shows how often a forecast was actually made about the season of interest by climate division. A value of 0.322 means a forecast covered some or all of the division about 32.3 percent of the time since 1994, when forecasts were available more than one month ahead. Scroll down to see the results you were seeking.

False Alarm Rate

This comparison considers how often the projected forecast turns out to be wrong, using the category that was predicted to be most likely. To convert the resulting climate division score into a percentage, just multiply the value by 100. So if forecasters called for wet conditions three times, but they only occurred twice, the false alarm rate would be 0.333 or 33 percent. Note that, in this case, low scores are good. To consider how often an issued forecast was accurate, just subtract the False Alarm Rate score from 1 (or the percentage from 100). In this theoretical example, the forecast was accurate 66 percent of the time. In the actual example tested here, scores ranged from 0.5 to 0.857 for "wet" conditions and from 0 to 0.75 for "dry" conditions (Figure 1b). Water managers have indicated they find the False Alarm Rate particularly relevant.

Show Data Behind the Map

If you want to see the forecasts that were considered for the evaluation, click on a climate division of interest and then click on the "Show the Data Behind the Map" option. First you'll see a description of how to interpret bubble plots, including a sample bubble plot. Then you'll see the data used for the climate division of interest for the season(s) and years indicated.

Besides the False Alarm Rate, there are a number of other options available for evaluating forecasts. To try other techniques, return to the Climate Forecast Performance page. (If you can't find it, return to the FET homepage and select "Forecast Performance.")

Modified Heidke Score

This selection is intended for use by the National Weather Service (NWS) forecasters who have historically used this approach to evaluate forecasts. It is included on the FET site because NWS forecasters receive instruction in use of this tool as part of their ongoing climate training courses, as explained by NWS Climate Services Chief Robert Livezey. He feels that for those not familiar with the Heidke system, the other methods provided (e.g. Frequency of Forecasts, Probability of Detection, False Alarm Rate, Brier Score,

(Continued on p. 4)

(Continued from p.3)

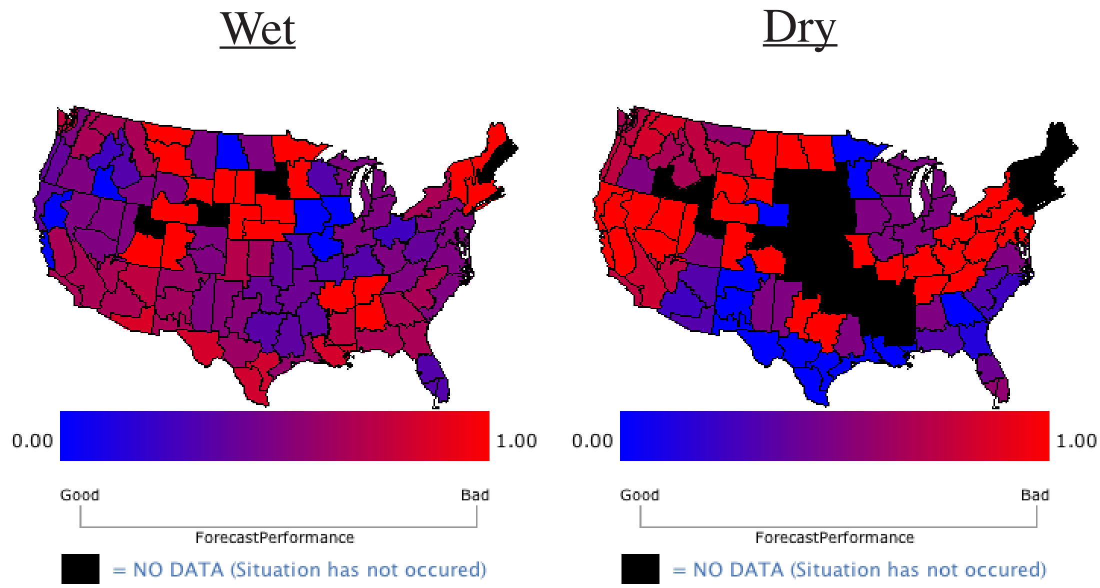


Figure 1b: An example result of the Forecast Evaluation Tool. The False Alarm Rate results for climate forecasts issued in November for the December-February season. Southeastern Utah's and south-central Colorado's winter forecasts tended to be the most successful of all the climate divisions in Colorado Wyoming and Utah, especially for predicting drier than average conditions (map at right). For example, the 0 scores in those divisions indicate that every forecast for dry conditions on the last decade panned out. Forecasts for wet winters in the Intermountain West region only came to pass about half the time or less (map at left).

and Ranked Probability Score) are more useful to understand the forecast performance.

Probability of Detection

This analysis indicates how often a forecast was made for non-average conditions compared to the total number of times it actually occurred. Your results will include separate maps for forecasts of above-average events (wet or warm) versus below-average events (dry or cool). To convert the resulting climate division score into a percentage, just multiply the resulting value by 100. A score of 0.346 for detecting wet conditions for the selected season means the CPC issued a forecast calling for above-average precipitation in about 34.6 percent of the cases in which precipitation tallies registered as above-average. Emergency managers have indicated they find these scores useful.

Ranked Probability and Brier Scores

While the Brier score differentiates categories into wet and dry (or warm and cool), the Ranked Probability score provides one lumped result for both conditions. Other than that, they have similar features. Both scores take into consideration the strength of the issued forecast. So, if above-average conditions prevail as the CPC had predicted, a forecast issued with a 70 percent probability gets a higher score than one issued with a 40 percent probability. Similarly, the 70 percent probability forecast takes a bigger penalty than the 40 percent probability if conditions turn out to be average—and an even bigger hit if conditions turn out to be below-average.

The Brier and Ranked Probability skill scores represent the proportion of time above and beyond what would be expected by chance (33 percent). That's partly why a climate division with a Probability of Detection score of 0.517 can translate into a Brier skill score of 0.086. This also explains why some of the skill scores turn up negative, indicating the viewer theoretically could have done better just by flipping a three-sided coin.

Customize your options

Now you have the know-how to consider how forecasts fare during a variety of seasons with a number of different lead times, using evaluation approaches that suit your needs. The website has many other features to explore on your own.

Want to know more?

If you have any questions about how the website works, you can send an email to: hydis_team@hwr.arizona.edu.

Support for development and implementation of the Forecast Evaluation Tool came from the National Oceanic and Atmospheric Administration, the NOAA-funded Climate Assessment for the Southwest (CLIMAS) and GEWEX Americas Prediction Project (GAPP) programs, the National Aeronautical and Space Administration, NASA's Hydrologic Data and Information System (HyDIS), EOSDIS Synergy programs, the National Science Foundation, and the NSF-funded Semi-Arid Hydrology and Riparian Area (SAHRA) Science and Technology Center.

Temperature through 12/31/05 Source: High Plains Regional Climate Center

The monthly average temperatures for December 2005 in the Intermountain West region ranged from lows of 0°F -15°F in the Gunnison Valley region of **Colorado**, north central **Colorado** mountains, and western **Wyoming** mountains to highs of 30°F-40°F in southeast **Colorado** and west central and southeast **Utah** (Figure 2a).

Across the region, temperatures were at or near record lows on some days in early December, and they were at or near record highs for some days in late December. These extremes averaged to give much of **Wyoming** and **Colorado** December monthly temperatures within 2°F of average. Exceptions included the Gunnison Valley and north central mountains of **Colorado**, and areas of south central and north central **Wyoming** where temperature were 4°F -10°F below average. Small regions in central and western **Utah** were 4°F -6°F above average (Figure 2b).

In comparison with the above-average temperatures for almost all of the tri-state region in December 2004 (Figure 2c) temperatures in December 2005 were generally closer to average. The exceptions were the Gunnison Valley and north central mountains of **Colorado**, where temperatures were 4°-10° below average. With minor exceptions, **Utah** was 2°F -4°F above average in both 2004 and 2005. Areas of south central and north central **Wyo-**

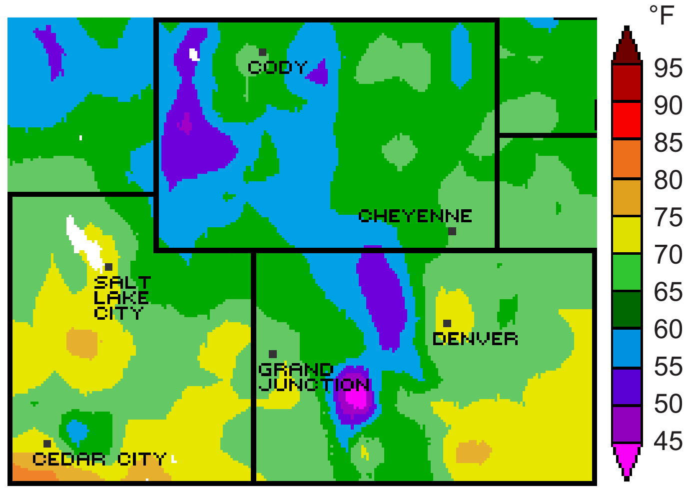


Figure 2a. Average temperature for the month of December 2005 in °F.

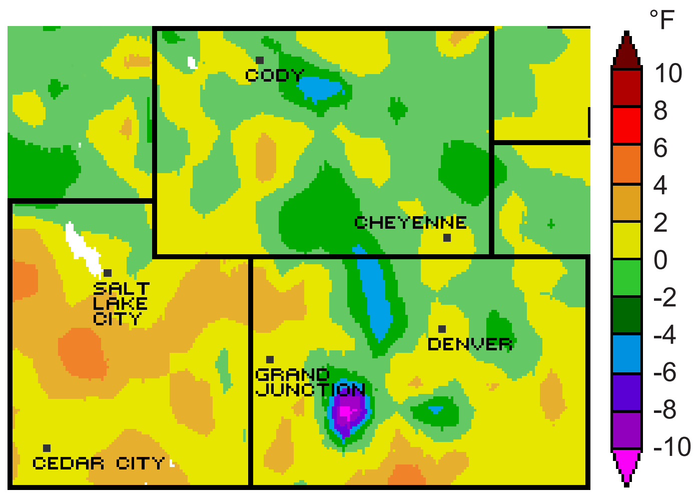


Figure 2b. Departure from average temperature for the month of December 2005 in °F.

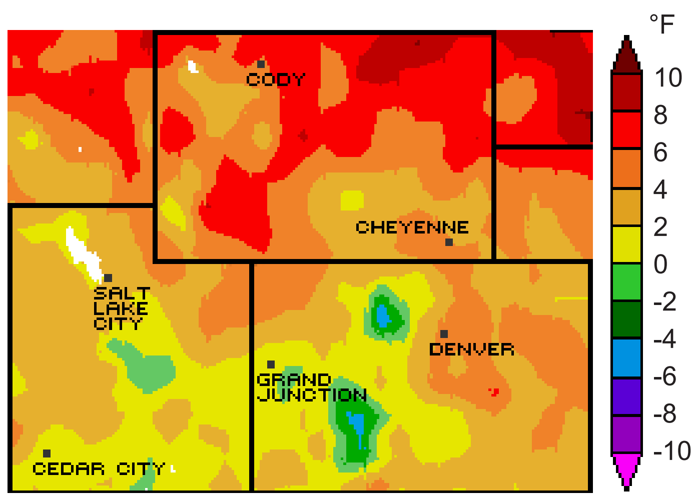


Figure 2c. Departure from average temperature in °F for last year, December 2004.

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.

Precipitation through 12/31/05 Source: NOAA/ESRL/PSD Climate Diagnostics Center, NOAA Climate Prediction Center

Precipitation in the Intermountain West region falls primarily as snow in December and snowpack and snow water equivalent (SWE) depend on elevation. Areas experiencing above average precipitation in December 2005 fell in the north-central mountains of **Colorado**, the central and western mountains of **Wyoming** and north central **Utah** (Figure 3a). These areas received from 1-3+ inches of precipitation in December, and this amount was 120% to 200% of average (Figure 3b). The eastern half of **Colorado** and southern and eastern **Utah** remain very dry, receiving from 0- 0.5 inches of precipitation, or about 40%-60% of average.

Since the start of the 2006 water year, October, 2005 (Figure 3c) **Colorado** has received average to above average precipitation in the northern half of the state, with the north central mountains and northeastern plains receiving 120% to 200% of average, while southern **Colorado** is average to below average with only 40% to 60% of average in the southeast. **Wyoming** received average precipitation for most of the state, with the exception of the southeast plains and northwest mountains with 120% to 150% of average precipitation. North-central and northwest **Utah** received 120% of average precipitation, the middle of the state received about average, and the southern portion received 40%-80% of average precipitation. The gradient of increasing precipitation from south to north is similar to a La Niña pattern. (See page 16 for ENSO outlook.)

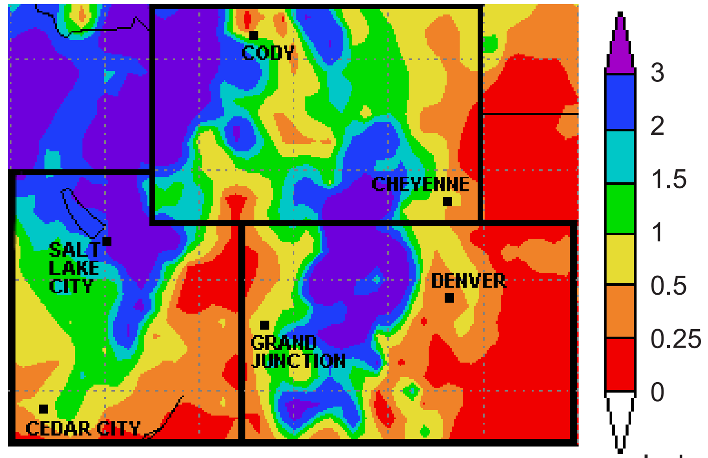


Figure 3a. Total precipitation in inches for the month of December 2005.

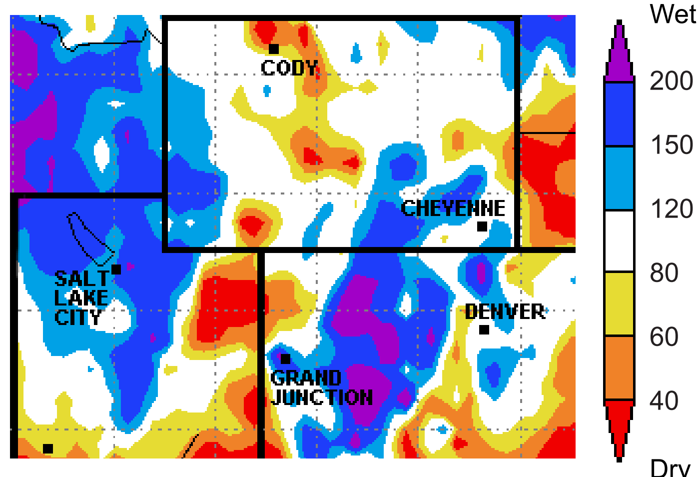


Figure 3b. Percent of average precipitation for the month of December 2005.

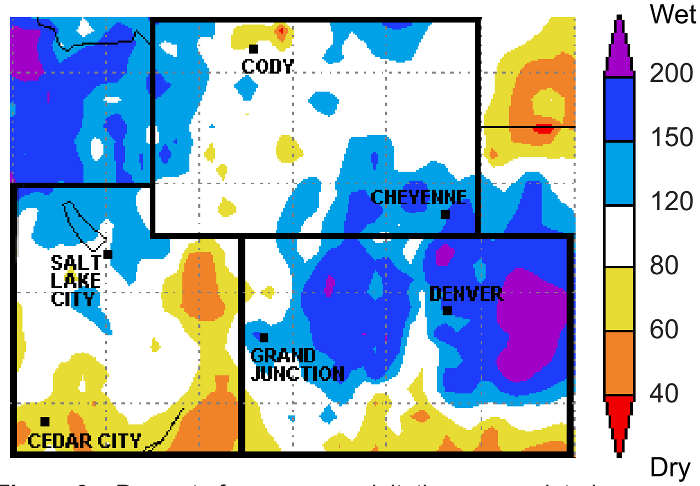


Figure 3c. Percent of average precipitation accumulated since the start of water year 2006. (Oct. 1 - Dec. 31, 2005).

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.

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://lwf.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 01/10/06

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

The drought status of most of the Intermountain West region remains esentially unchanged from last month, with the exception of dryness persisting across southern **Colorado**, leading to an expansion of D0 (abnormally dry conditions) into that area. In other areas of the west, western Arizona moved into D0 status and eastern Arizona moved into D2 (severe) drought status. Contrasting that are portions of the Pacific Northwest have moved out of drought.

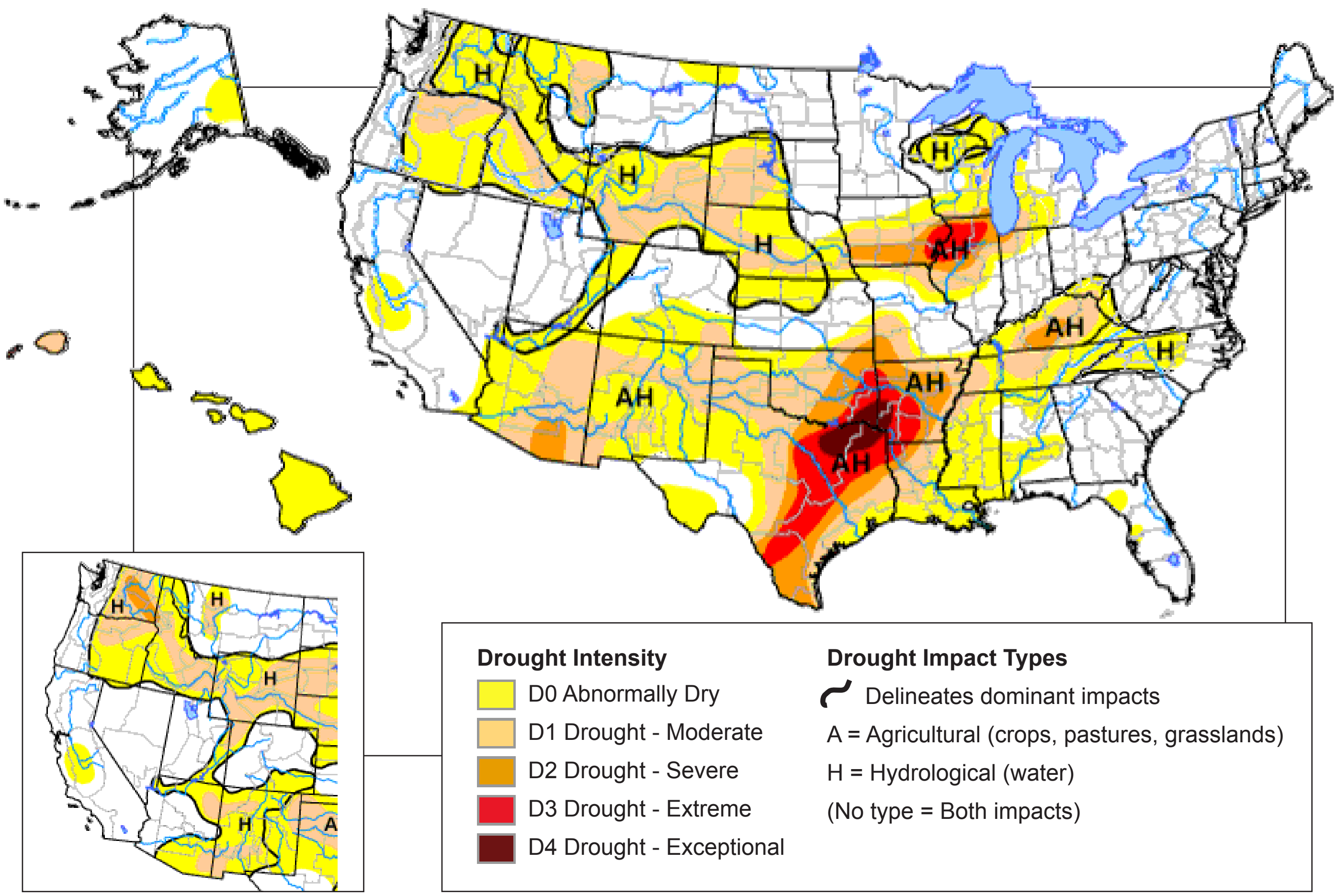


Figure 4. Drought Monitor released January 12, 2006 (full size) and last month December 15, 2005 (inset, lower left) for comparison.

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 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 **released 01/10/06**

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

The snowpack as of January 1, 2006 varies across the Intermountain West Region and throughout the states. About half of the state of **Wyoming** is above average, which is a positive sign since these areas had a dry winter last year. The snowpack in the central basins and the Lower North Platte River basin range from near average to 70% of average. The Green River basin in the west and the Upper North Platte River basin in the south both have 110%-130% of average snowpack. The only area with above 150% of average snowpack is the Belle Fourche River basin in the northeast corner of **Wyoming**.

Utah and **Colorado** show a distinct south-to-north gradient in snowpack levels. The southern parts of both states have areas below 50% of average snowpack, while the northern mountains have areas where the snowpack is 130% -150% of average. In **Utah**, the basins from the Provo and Price north have above average snowpack and the basins from the Upper Sevier and Dirty Devil south have below average snowpack. In **Colorado**, the dividing line is the Gunnison Basin on the west slope and the Arkansas basin on the east. Further south (not shown) in Arizona and New Mexico, all stations measure under 50% of average snowpack for this time of year. This gradient is characteristic of a La Niña pattern, which is developing according to NOAA. (See page 16 for more ENSO information.)

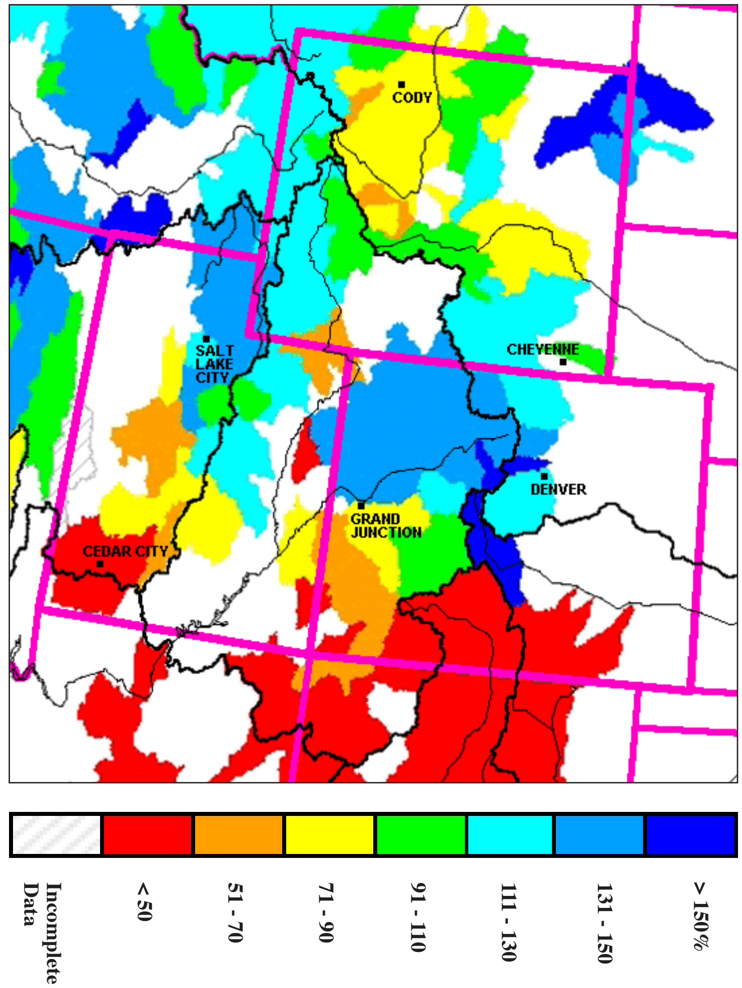


Figure 5. Snow water equivalent (SWE) as a percent of average for available monitoring sites in the Intermountain West as of January 1, 2006

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 17 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 12/31/2005

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

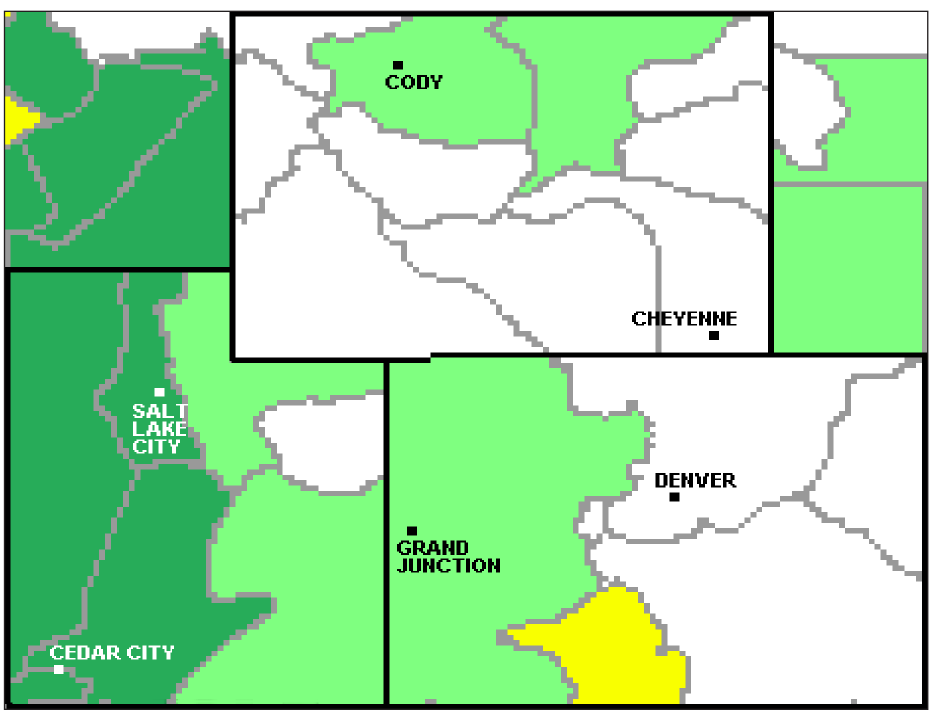
The Standardized Precipitation Index (SPI) can be used to monitor conditions on a variety of time scales. 3- and 6-month SPIs are useful in short-term agricultural applications and longer-term SPIs (12 months and longer) are useful in hydrological applications. The 12- month SPI for the Intermountain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

The SPI is mostly in the near normal to wet range around the Intermountain West region as of the end of December 2005. Western **Colorado** is near normal, while the Rio Grande basin in the south-central part of the state continues to be moderately dry. There was some improvement in the Colorado River basin, which moved from near normal to moderately wet last month. **Wyoming** had some improvements as well, in the Upper Platte division in the south-central part of the state and the Yellowstone division moving out of dry conditions into near normal conditions. The north-central part of **Wyoming** remains moderately wet while the rest of the state is near normal. **Utah** continues to be moderately wet with the western part of the state very wet. The southeast division SPI decreased slightly since last month from very wet to moderately wet.

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.



+3.00 and above	Exceptionally Wet
+2.00 to +2.99	Extremely Wet
+1.25 to +1.99	Very Wet
+0.75 to +1.24	Moderately Wet
-0.74 to +0.74	Near Normal
-1.24 to -0.75	Moderately Dry
-1.99 to -1.25	Very Dry
-2.99 to -2.00	Extremely Dry
-3.00 and below	Exceptionally Dry

Figure 6. 12-month Intermountain West regional Standardized Precipitation Index. (data through 12/31/05)

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 January 2006

Source: USDA Natural Resources Conservation Service

The percent of average SWE in Colorado varies throughout the state as of January 4, 2006 (Figure 7a). The mountains surrounding the Rio Grande River basin have 60% to less than 40% of normal SWE. On the other hand, the northern mountains along the continental divide have had considerable snow since October and they range from 100 % to above 160% of normal snowpack.

The Surface Water Supply Index (SWSI) is another useful measure of water availability related to streamflows, reservoir levels, and groundwater levels. Like the SWE map, the Colorado SWSI map shows more water supplies in the north and less in the south. The Dolores/San Juan and Rio Grande basins are in drought categories, with the Rio Grande approaching severe drought. The rest of the state is either near or above normal. The Arkansas and Colorado River basins are approaching abundant supply. In a CBS4 online news story from January 6, 2006, State climatologist, Roger Pielke Sr., noted that the southern part of the state is facing conditions comparable to the drought of 2002.

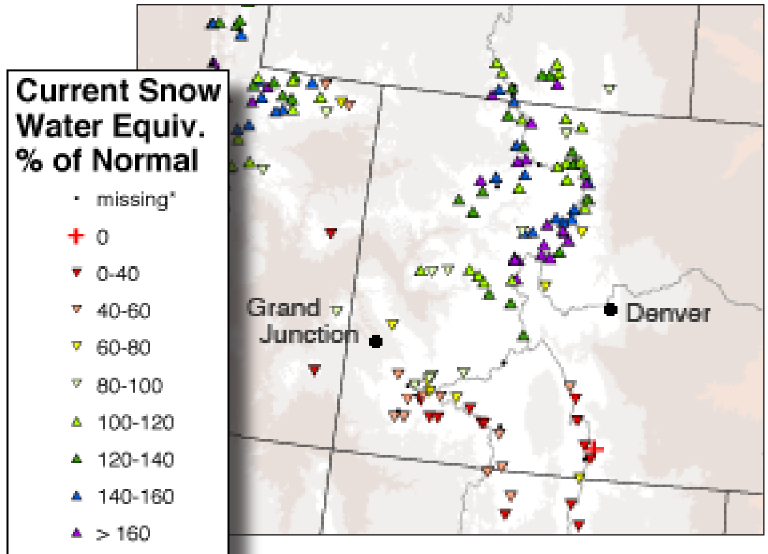


Figure 7a. Currrent snow water equivalent (SWE) as a percent of normal for SNOTEL sites in Colorado as of January 4, 2006. **This is provisional data**. For current SNOTEL data and plots of specific sites, see http://www.cbrfc.noaa.gov/snow/snow.cgi or http://www.wcc.nrcs.usda.gov/snow/.

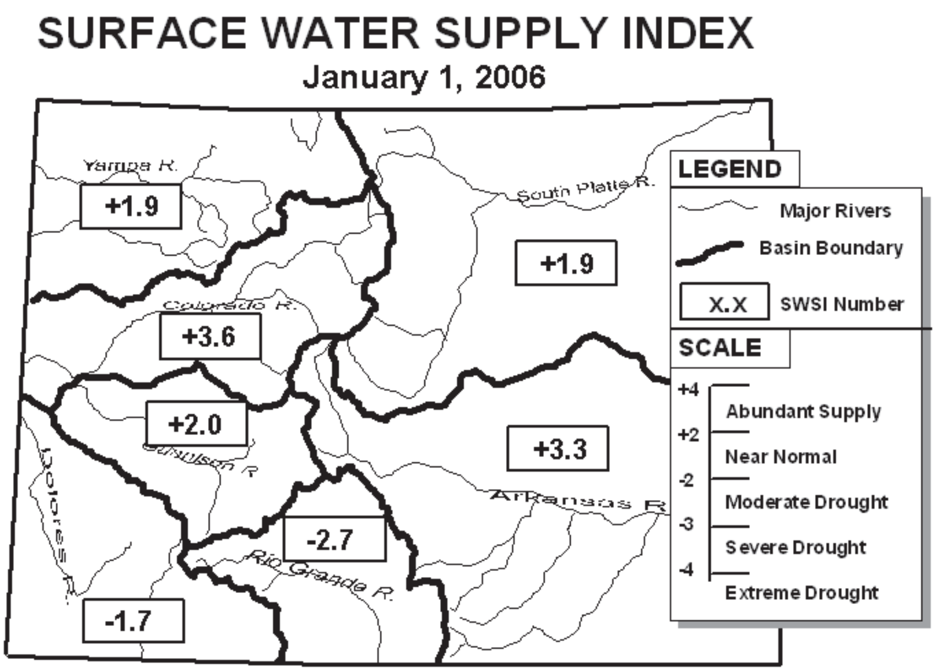


Figure 7b. Colorado Surface Water Supply Index. The map shows the projected water availability by basin for spring and summer 2006, based on current conditions as of January 1. (released 1/10/06)

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 January 1, 2006, and reflect conditions during the month of December 2005.

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/.

Wyoming Water Availability January 2006

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

The current SWE as a percent of average varies across the state of Wyoming as of January 4, 2006 (Figure 8a). The south-central mountains and the western mountains generally have above average snowpack levels, ranging from 100% - 160% of average SWE. The central mountains bordering the Big Horn and Powder River basins only have between 40% - 120% of average SWE. Some stations in the Shoshone and Wind River basins have less than 60% of average SWE.

The Surface Water Supply Index (SWSI) varies across the state of Wyoming as if January 1, 2006. The Upper Snake and Big Sandy River basins in the west are the driest with moderate drought conditions. Other basins facing a mild drought include the Wind, the Big Horn, and the Powder, River basins. The wettest basin is the Upper North Platte basin, which is between slightly and moderately wet.

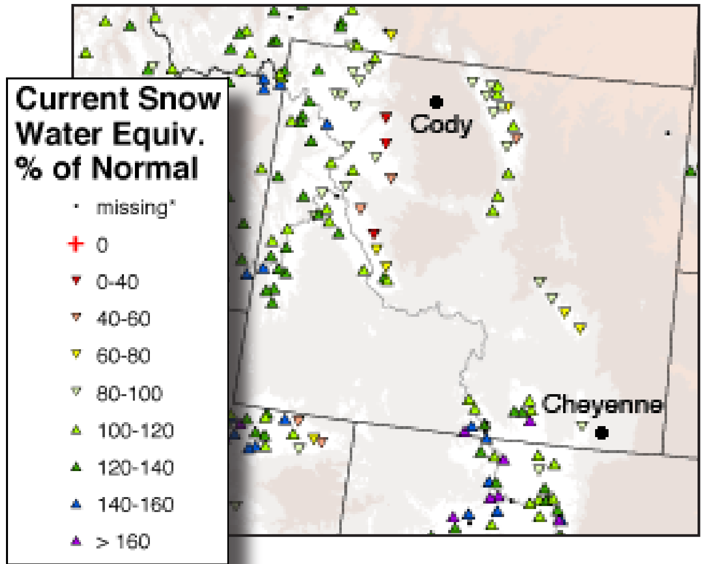


Figure 8a. Currrent snow water equivalent (SWE) as a percent of normal for SNOTEL sites in Wyoming as of January 4, 2006. **This is provisional data**. For current SNOTEL data and plots of specific sites, see http://www.wcc.nrcs.usda.gov/snow/.

Notes

Figure 8a shows the SWE as a percent of average for each of the major river basins in Wyoming. According to the 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."

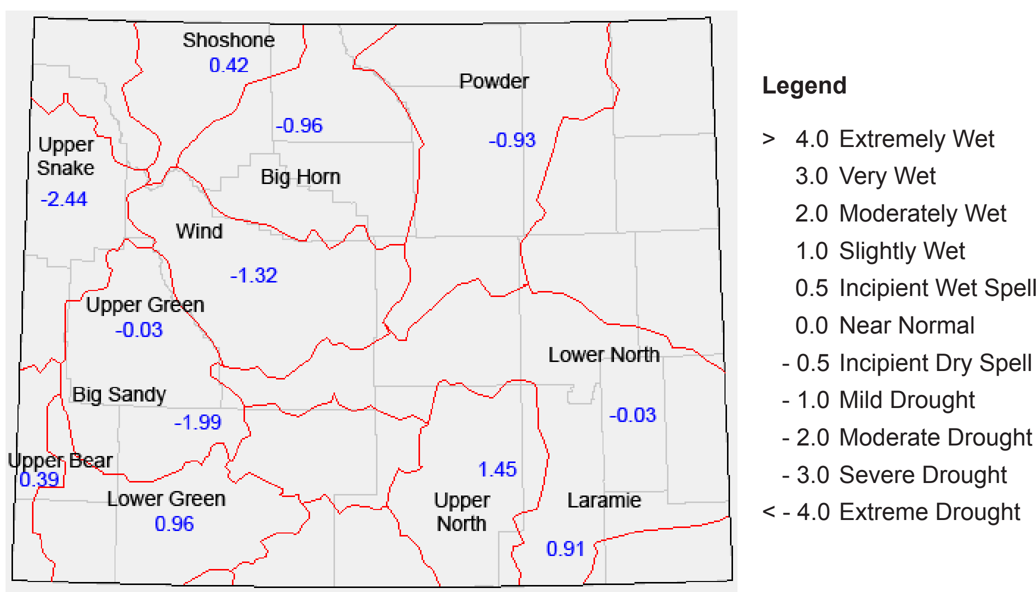


Figure 8b. Wyoming Surface Water Supply Index (released 1/06/06)

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 January 2006

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

The current SWE as a percent of normal varies through out the state of Utah as of January 4, 2006 (Figure 9a), but in general the northern mountains have had more snow than the southern mountains, like in Colorado. Some southern SNOTEL sites as well as the western and eastern most sites have 0% - 40% of normal SWE. On the other hand, parts of the Bear, Weber, Provo and Uintah River basins, generally have from 100% - 160% of normal SWE. This snowfall pattern is opposite from most of last year, when the southwestern part of the state had the highest SWE numbers and percent of normal.

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. The southern basins are low with the Moab, Upper, and Lower Sevier basins below zero and the Beaver and Virgin basins just slightly above zero. The southern part of Utah had below average precipitation in about half of the months between July and December 2005. In addition, these basins have also had very low snowfall since the start of the winter season. Lower reservoir levels may also contribute to the lower SWSI numbers this month. With the exception of the Bear basin, which has the lowest SWSI at -2.4, the northern basins are above average. The Weber, Provo, West Uintah, Price, and San Rafael basins have SWSI numbers of 2 or greater.

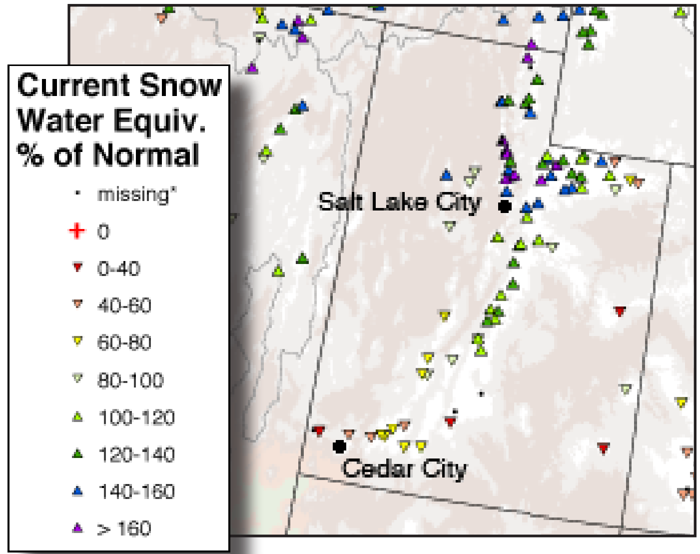
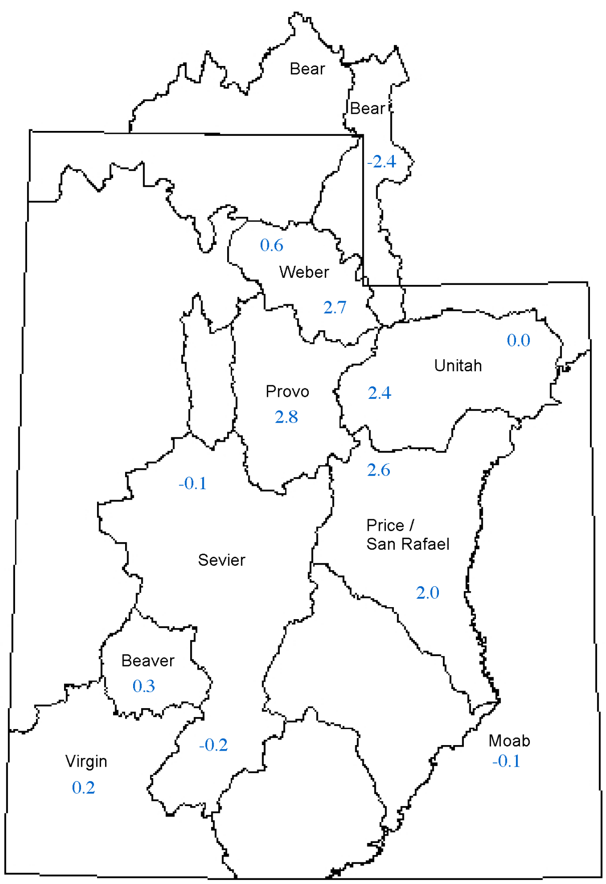


Figure 9a. Currrent snow water equivalent (SWE) as a percent of normal for SNOTEL sites in Utah as of January 4, 2006. **This is provisional data.** For current SNOTEL data and plots of specific sites, see http://www.cbrfc.noaa.gov/snow/snow.cgi or http://www.wcc.nrcs.usda.gov/snow/



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 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 (released 1/06/06).

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 January - May 2006 Source: NOAA Climate Prediction Center

According to the outlook released Dec 15, 2005 by the NOAA Climate Prediction Center, a large area of the U.S., including much of the Intermountain West, has an increased risk of above average temperatures in January 2006 (Figure 10a) and forecast periods through the spring of 2006 (Figures 10b-d). Much of **Utah** and **Colorado** are included through the March-May 2006 forecast period, and much of the region through summer forecast periods (not shown). **Wyoming** is not included in the area of increased risk of above average temperatures after Janurary 2006, because La Nina-like conditions elevate the chances for below normal temperatures in the northern tier of the U.S. This risk of cool temperatures largely counteracts the recent warming trends and brings temperature probabilities in these areas in line with 1971-2000 climatology. The CPC will update the seasonal temperature forecasts on Thursday, January 19th.

This forecast utilizes a new forecast tool that should significantly improve temperature forecasts over the continental U.S, including the Intermountain West. The tool combines several statistical models and a 15-member ensemble mean from dynamic models using the known skill of the various tools to form a weighted average. This new tool helps to reduce the uncertainty which forecasters confront when they try to subjectively combine various forecast tools.

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.

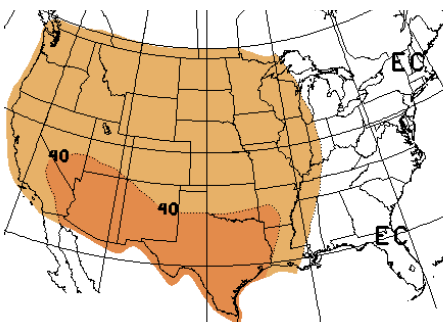


Figure 10a. Long-lead national temperature forecast for January 2006. (released Dec. 30, 2005)

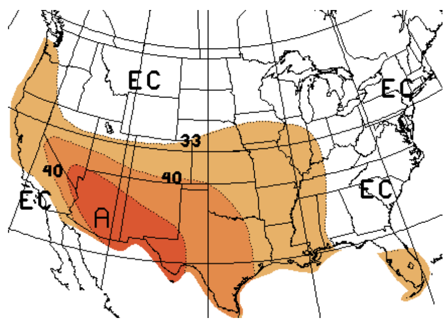


Figure 10b. Long-lead national temperature forecast for Jan. – Mar. 2006. (released Dec. 15, 2005)

A = Above
- 60.0–69.9%
- 50.0–59.9%
- 40.0–49.9%
- 33.3–39.9%

B = Below
- 40.0–49.9%
- 33.3–39.9%

EC = Equal Chances

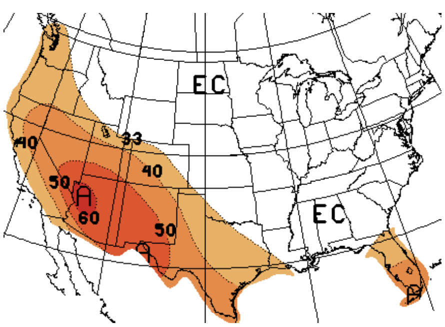


Figure 10c. Long-lead national temperature forecast for Feb. – Apr. 2006. (released Dec. 15, 2005)

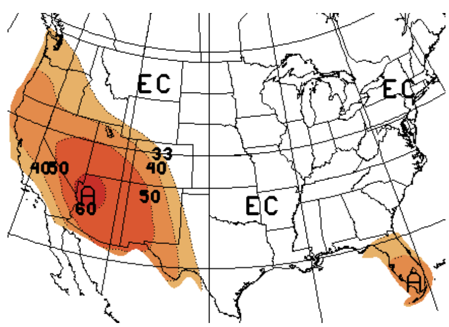


Figure 10d. Long-lead national temperature forecast for Mar. – May 2006. (released Dec. 15, 2005)

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 January - May 2006 Source: NOAA Climate Prediction Center

The winter and spring seasonal precipitation forecasts issued December 15th 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 Jan-March 2006 forecast periods (Figure 11a-d). However, La Nina conditions are associated with dry conditions in the winter in the Southwestern U.S., and these conditions typically extend into southern **Colorado** and **Utah**.

According to CPC, sea surface temperatures (SSTs) and atmospheric conditions, which are currently neutral, are trending toward weak La Nina conditions. CPC thinks that the Pacific is close enough to La Nina conditions to impact the climate for Jan-Mar 2006. However, the reliability of anticipated impacts is lower than would be expected in a moderate or strong La Nina event. The CPC will update the seasonal precipitation forecasts on Thursday, January 19th, based on the latest observations of La Nina and other factors.

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 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.

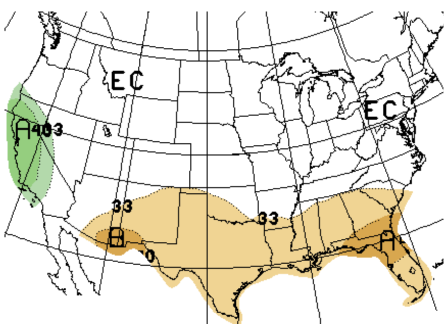


Figure 11a. Long-lead national precipitation forecast for January 2006. (released Dec. 30, 2005)

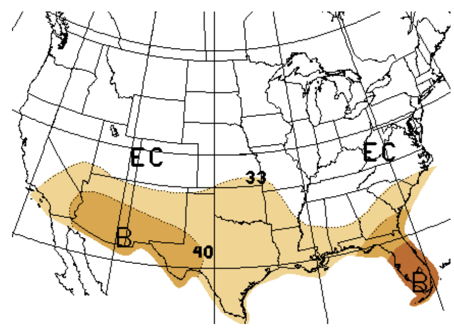


Figure 11b. Long-lead national precipitation forecast for Jan. – Mar. 2006. (released Dec. 15, 2005)

A = Above

40.0–49.9%

33.3–39.9%

B = Below

40.0–49.9%

33.3–39.9%

EC = Equal Chances

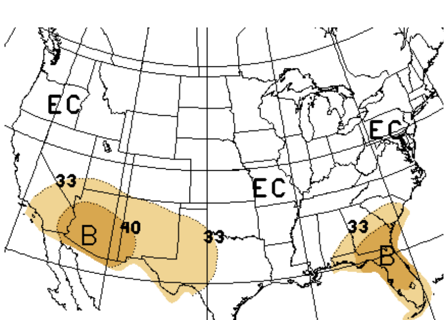


Figure 11c. Long-lead national precipitation forecast for Feb. – Apr. 2006. (released Dec. 15, 2005)

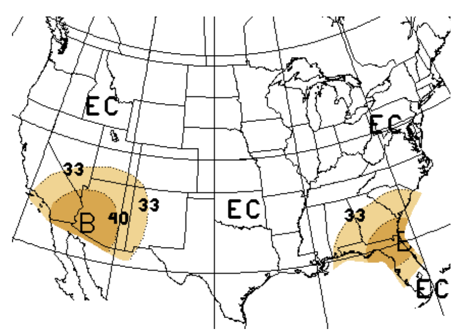


Figure 11c. Long-lead national precipitation forecast for Mar. – May 2006. (released Dec. 15, 2005)

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.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 March 2006

Source: NOAA Climate Prediction Center

The most recent NOAA seasonal Drought Outlook was released on December 15, 2005. Little change in the drought situation is expected from eastern **Wyoming** into South Dakota and Nebraska, but some improvement is indicated for the Northwest and northern Rockies. Abnormally dry weather through the first half of December has led to expanding drought across parts of the Southwest and southern Plains. The latest official precipitation outlook for January-March 2006 shows increased risk of dry conditions. Therefore, prospects for improvement in that region look dim into the first quarter of the new year, and the risk for drought expansion has increased from Arizona eastward through New Mexico and northern Texas.

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.

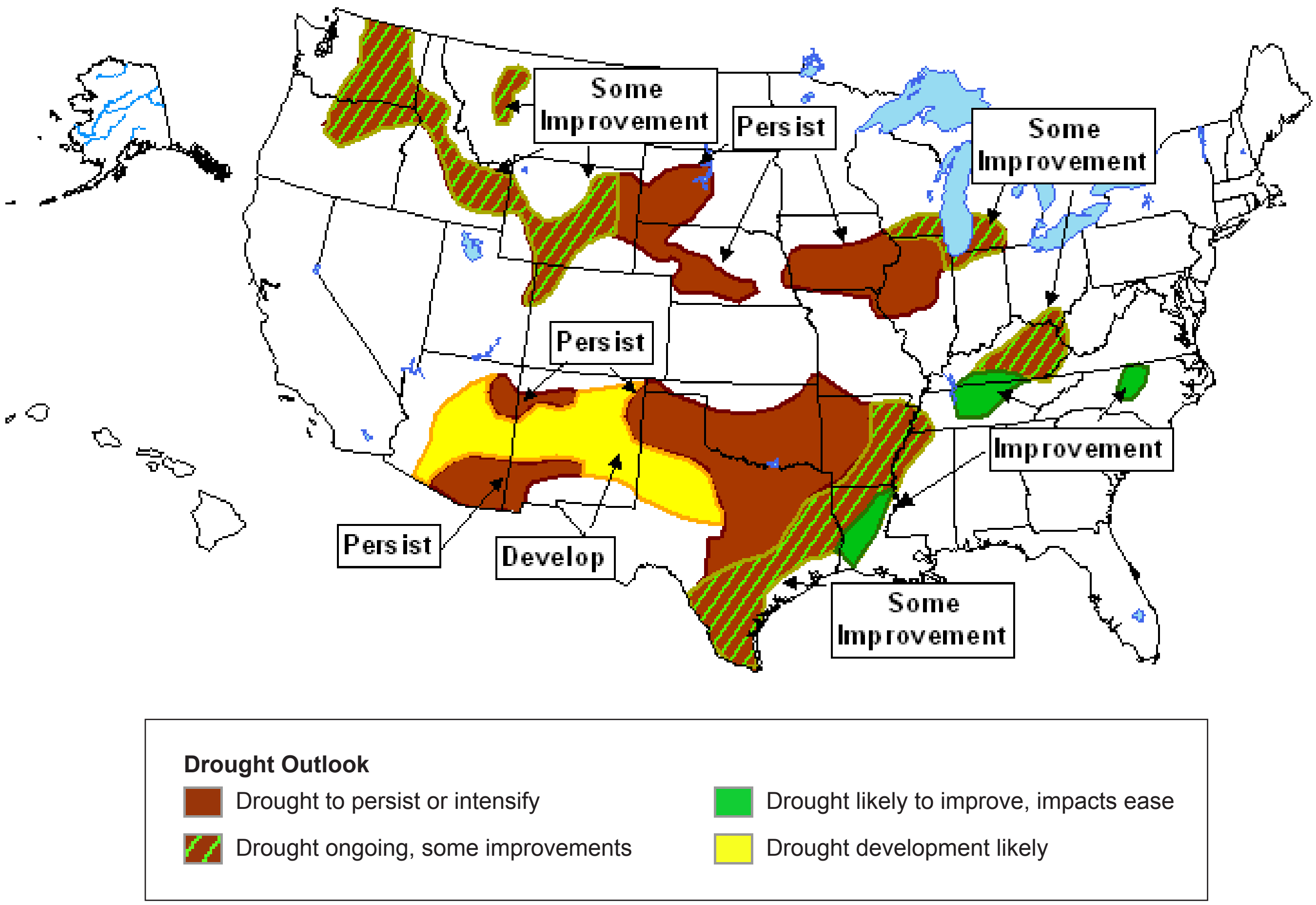


Figure 12. Seasonal Drought Outlook through March 2006 (release date December 15, 2005).

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 the NOAA CPC ENSO Diagnostic Discussion issued January 12, 2006, La Niña conditions have been developing, and are expected to continue during the next 3-6 months. During the last two months, SSTs and subsurface temperatures have decreased in the eastern tropical Pacific and in the Niño 3.4 region, which is the basis of the official forecasts (Figure 13a). Collectively, these oceanic and atmospheric observations are consistent with the development of La Niña conditions. The most recent statistical and coupled model forecasts from NOAA and other sources indicate either ENSO-neutral conditions or the development of a weak La Niña (Figure 13b). To officially call these anomalies a La Niña, NOAA's definition requires a negative sea surface temperature anomaly, averaged over three months, greater than or equal in magnitude to 0.5oC in the Niño 3.4 region of the eastern equatorial Pacific region. A La Niña is generally accompanied by a northward shift of the jet stream in the eastern Pacific, and this is usually accompanied by drier-than-normal conditions over southern California and Arizona and wetter conditions in the Pacific Northwest. NOAA cautions that given the late onset of this event there is considerable uncertainty as to whether or not typical La Niña conditions will manifest themselves in the western United States. However, the persistent dry conditions in the Southwest -- including southern **Utah** and Arizona -- and the persistent wet conditions in the northwest, are typical of a La Nina.

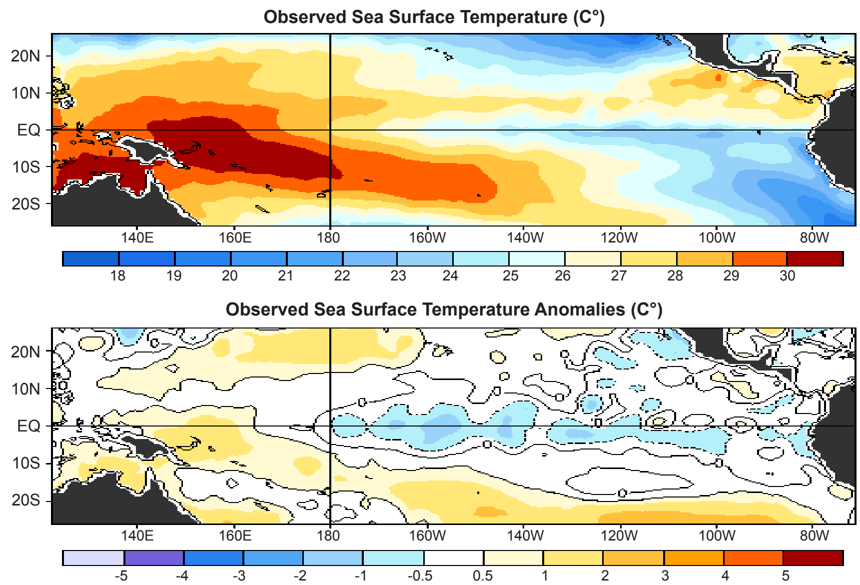


Figure 13a. Two graphics showing the observed SST (upper) and the observed SST anomalies (lower) in the Pacific Ocean. The Niño 3.4 region encompasses the area between 120° W-170° W and 5° N-5° S. The graphics represent the 7-day average centered on January 4, 2006.

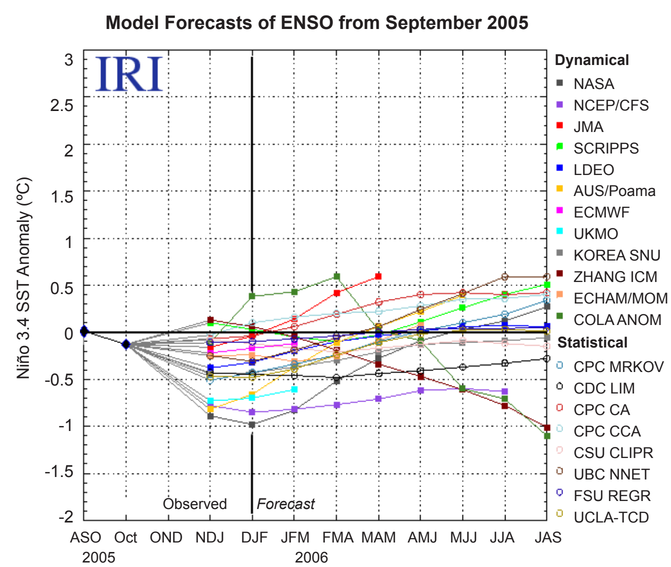


Figure 13b. Forecasts made by dynamical and statistical models for sea surface temperatures (SST) in the Niño 3.4 region for nine overlapping 3-month periods from December 2005 to October 2006 (released December 15, 2005). Forecasts are courtesy of the International Research Institute (IRI) for Climate Prediction.

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.

On the Web

- For a technical discussion of current El Nino conditions, visit: http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/enso_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/enso.shtml#current.
- For more information about El Nino, 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

The first water supply outlooks for the season are issued in January, and are a cooperative effort of NOAA River Forecast Centers (RFCs) and the NRCS. The **Colorado Basin RFC** Water Supply Outlook for the Upper Colorado, for January 1st, forecasts April-July runoff volume for major basins in the Upper Colorado. This product also provides specific site forecasts for some stations, and basin conditions compared to average for December precipitation, water year precipitation, snow water equivalent, December streamflow, and reservoir contents. The outlook reflects the dichotomy of precipitation levels throughout the Colorado River Basin (See Recent Precipitation on page 6 and Snowpack on page 8.), projecting slightly above average "most probable" April-July 2006 inflows for all the major reservoirs in the upper basin (106-108% compared to the 1971-2000 average) except for Navajo Reservoir on the San Juan River in **Colorado** (65%). Note that these are probabilistic, not deterministic forecasts. You can find the product on the web, including minimum probable and maximum probable runoff, at http://www.cbrfc.noaa.gov/wsup/wsup.cgi.

The NOAA **West Gulf RFC** water supply forecast for the Rio Grande River basin summarizes conditions and projects runoff volume for April-September and March-July 2006 periods (See http://www.srh.noaa.gov/wgrfc/watersupply/html/default.html). The most probable runoff for Rio Grande forecast points in **Colorado** is 45-77% of the 1971-2000 average. The **Arkansas RFC** will issue its volume forecasts on April 1st.

The NRCS summarizes forecasts across the region in a map (Figure 14). In addition to streamflow forecasts for the Upper Colorado and Rio Grande River basins, this map shows streamflow forecasts by category for the other river basins in the Intermountain West Region. In **Wyoming**, the Missouri River basin streamflow forecasts range from around average to 70% of average, while the North Platte River basin is up to 150% above average in some areas. The rest of the state is around average. In **Colorado,** the South Platte and upper Arkansas River basins are up to 150% of average. Finally, the streamflow forecasts for the Great Basin in western **Utah** range from 50%- 69% of average in the south to near average in the north.

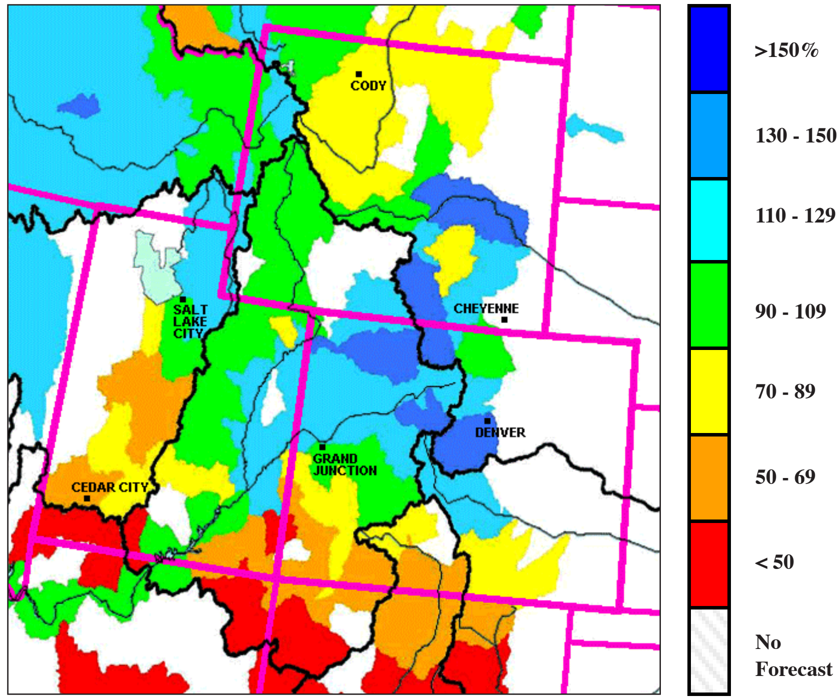


Figure 14. NRCS map showing the expected natural streamflows for spring and summer in the Intermountain West region as a percent of average streamflows. (Dated January 1, 2006.)

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 (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/.

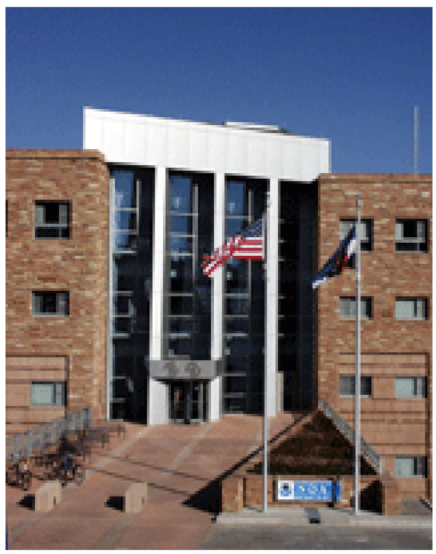
The official NOAA streamflow forecasts are available through the following websites of individual River Forecast Centers:

- 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/

NOAA Restructures Research Efforts: Creates Earth System Research Laboratory in Boulder, CO

You may have noticed a change in the name on the front page and for some of our sources in the last two issues of the Intermountain West Climate Summary. The lab formerly known as the Climate Diagnostics Center – home of Western Water Assessment – has been incorporated into the new NOAA Earth System Research Laboratory (ESRL). The National Oceanic and Atmospheric Administration (NOAA) restructured and consolidated its research efforts in Boulder, CO and, in October 2005, formed a single laboratory focusing on earth system research. The lab includes four divisions: Global Monitoring, Physical Sciences, Chemical Sciences, and Global Systems.

"This single laboratory will help NOAA better deal with the research challenges of this new century, in which the environmental issues we face cross the traditional disciplinary boundaries and demand a 'whole Earth' perspective," said Dr. Richard D. Rosen, former assistant administrator for NOAA's Office of Oceanic and Atmospheric Research, also known as NOAA Research. Rosen added that the headquarters structure of NOAA Research also will be reorganized to improve communication and better coordinate research within NOAA. The changes are based on recommendations of a 2004 Congressionally mandated review of research within NOAA. Rosen held this post during the reorganization. The new head of Atmospheric Research is Dr. Richard Spinrad. A search is underway for a director of ESRL.



NOAA's David Skaggs Research Center
Boulder, CO

The ESRL Physical Sciences Division

The Climate Diagnostics Center is now part of the new Physical Sciences Division (PSD), which will carry out research on climate and weather processes, diagnostics, modeling, empirical analyses, focused field observations, and supporting technology development. The Climate Diagnostics Center joins workgroups from the Aeronomy Laboratory and the Environmental Technology Laboratory to form PSD. This reorganization unifies the various weather and climate observations, diagnostics and process modeling research that has been occurring across the former three laboratories. The merged Physical Sciences Division focuses combined resources and talents to advance several key NOAA mission goals in weather and climate:

- Improve the analysis and diagnosis of the weather and climate system to advance short-term, intraseasonal-to-interannual predictions, and climate change projections.
- Explain weather and climate processes with a focus on the physical and dynamical forcing agents responsible for their variations.
- Advance a predictive understanding of the Earth System with quantified uncertainties for making informed and reasoned decisions regarding climate and weather processes occurring on time scales of weeks to decades.

The mission of PSD is to address physical science questions of short- and long-term societal and policy relevance within NOAA's Climate, Weather, and Water Goals. PSD will conduct the physical process research necessary so that ESRL can help provide the nation with a seamless suite of information and forecast products ranging from short-term weather forecasts to longer-term climate forecasts and assessments. PSD aims to provide the observation, analysis, and diagnosis of weather and climate physical processes necessary to increase understanding of Earth's physical environment, including the atmosphere, ocean, cryosphere (frozen water), and land, and to enable improved weather and climate predictions on global-to-local scales.

Integration of the PSD within ESRL

PSD joins three other divisions to form ESRL. The new "super-lab" brings together integrated expertise in weather and climate physical observations, modeling, analysis and applications. PSD's central focus on physical process research both supports and is supported by the other divisions in the following ways:

- The *Global Systems Division* provides observations, modeling, and computational and display systems development.
- PSD helps explain trends and changes in the environment observed by the *Global Monitoring Division*.
- PSD collaborates with the *Chemical Sciences Division* to improve the understanding, diagnoses, and prediction of air quality on time scales ranging from weather to short-term climate. The two divisions will also develop an improved understanding for the interrelationships and physical consequences of current and future chemical states of the atmosphere.

ESRL's coordinated research effort will benefit the Intermountain West water-management community by improving collaboration among climate and weather researchers. The Western Water Assessment can then disseminate new information and research products to our stakeholders.

On the Web
- NOAA: http://www.noaa.gov
- NOAA's Earth System Research Laboratory: http://esrl.noaa.gov/
- 2004 Research Review Team Report: http://www.sab.noaa.gov/Reports/Reports.html