

INTERMOUNTAIN WEST CLIMATE OUTLOOK



by The Western Water Assessment

Issued January 21, 2005

January 2005 Climate Summary

Hydrological Drought – Hydrological drought continues in much of the Interior West, but there has been little change in most areas since late November. Drought status has deteriorated in parts of Wyoming due to low snow water equivalent, but there has been some improvement in northeastern Utah.

Temperature – The Intermountain West region experienced warmer than average temperatures for the month of December, which is consistent with the warmer temperatures for all of 2004.

Precipitation – Utah and western Colorado experienced above average precipitation in December and since the start of water year 2005, but eastern Colorado and Wyoming experienced average or below average amounts of precipitation. This pattern is consistent with past annual precipitation trends for each state.

Climate Forecasts – Long-lead forecasts call for increased chances of above-average temperatures in western Colorado and most of Utah for the next 6 months. Slightly increased chances of wetter-than-average conditions also are predicted for parts of Utah and Colorado through May 2005.

El Niño – Sea surface temperatures in the tropical Pacific Ocean remain indicative of a weak El Niño, which is expected to continue at least until May 2005. However, the lack of persistent enhanced convection over these anomalously warm waters in the central equatorial Pacific has limited El Niño impacts on the global pattern of precipitation.

The Bottom Line – The Intermountain West is expected to see limited improvement in drought conditions through early 2005, however, the outlook favors some overall improvement in the region this season based on early trends and the developing El Niño.

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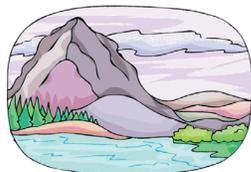
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INTRODUCTION TO WESTERN WATER ASSESSMENT AND THE INTERMOUNTAIN WEST CLIMATE OUTLOOK.

The Western Water Assessment (WWA) is an integrated research project composed of scientists from NOAA, the University of Colorado and Colorado State University who produce information about natural climate variability and human-caused climate change.



provides the latest climate information in an easily accessible and understandable document aimed at water managers.

This is the prototype outlook and we hope you will provide us with helpful comments and suggestions about how we can provide you with the information you need to make annual operations and long-term planning decisions.

The Intermountain West climate outlook

Contact Us - We want to hear your questions and feedback! Please e-mail us at WWAoutlook@sciencepolicy.colorado.edu

Disclaimer - This is a prototype product 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.

A Meteorological Perspective on Drought

By Klaus Wolter, NOAA Climate Diagnostics Center and University of Colorado at Boulder

How did we get into our current situation?

In much of Colorado, the 1980s and 90s were climatologically benign. Dry years were rare, and some of the wettest years on record were observed in the Front Range in particular. If you moved into our state during this period, you might have gotten a misleading impression about typical conditions around here, – just as someone investing in the stock market might have expected to see returns continue at a 1990s clip.

Beginning in September 1999, Colorado experienced severe drought conditions,

part of a global drought regime that covered a large fraction of the U.S., the Mediterranean, and Southwest Asia for the following three years. It resulted in two of the worst wildfire seasons ever recorded in the Western U.S., 2000 and 2002. With reservoirs being drawn down from preceding wet years, it was easy to ignore the initial signs of drought. However, the third and worst drought year (2001-02), resulted in record-low streamflows, and record-high wildfire coverage. Statewide, it was one of the the driest years ever observed for much of Colorado, including the foothills southwest of Denver that suffered through the Hayman fire in June

2002. Nevertheless, the drought periods of the 1950s and '30s were longer lasting, and had probably more severe impacts.

Near-normal moisture returned during the subsequent water year (2002-03) over northern Colorado, while much of southern Colorado suffered through a fourth drought year. With local exceptions, statewide snowpack tallies remained below normal both in early 2003 and 2004. These deficiencies continued to strain reservoir management, despite abundant summer moisture in 2004 in much of eastern Colorado. Since September 2004, southwestern Colorado has benefited

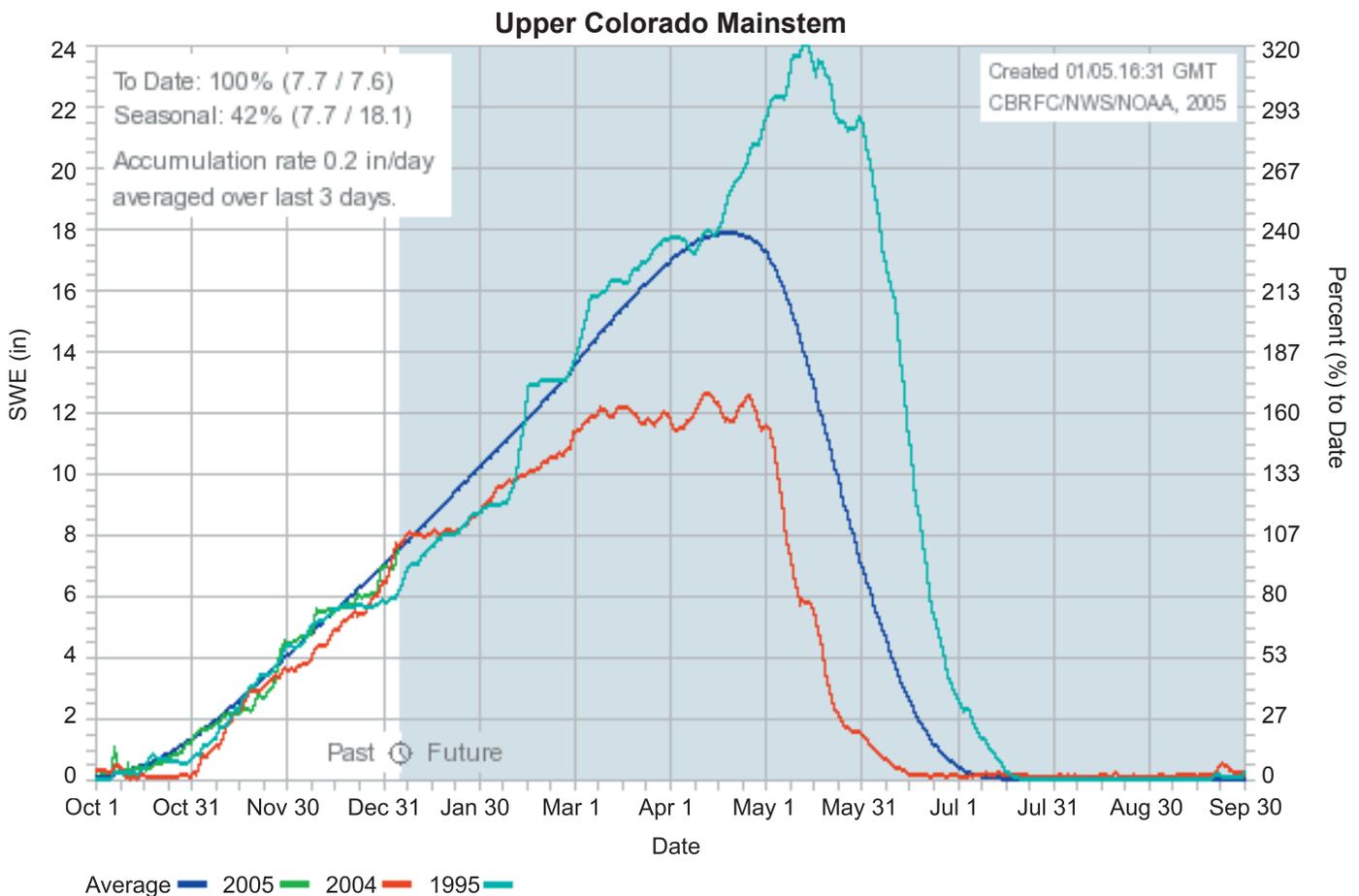


Figure 1: Snowpack levels converted into snow water equivalent (SWE) for selected SNOTEL stations in the Upper Colorado watershed in Colorado. Note the long persistence of the snowpack into the spring in 1995 compared to the average, as well as to 2004 when a low snowpack melted out fairly early.



from an exceptionally active early season that has created above-normal snowpack conditions, while the northern mountains continue to experience just below normal moisture until recent weeks.

What do we know about droughts?

Do droughts come in ‘cycles’? Despite a tendency for Western U.S. droughts to occur about once every two decades – most notably during the 1930s and 50s –, careful analysis reveals more complex behavior, especially over northern Colorado. The duration of droughts can vary from a brief, so-called ‘flash’ drought like last July’s heatwave to a seven-year drought like the ‘dustbowl’ period of the 1930s, and even longer droughts in the tree-ring record. Therefore, the length of a recent dry spell should not be used to predict the duration of a drought.

How do droughts get ‘broken’?

In much of Colorado, especially along the Front Range, and towards the San Juans, long-lasting ‘La Niña’ events have been associated with drought, while a switch to ‘El Niño’ is one of the more reliable indicators for a possible recovery. Here, the term El Niño refers to warmer-than-normal sea surface temperatures in the eastern tropical Pacific basin, while La Niña refers to the opposite phase. For example, the 1930s drought was replaced by wet conditions during the long-lasting El Niño of the early 1940s, and the 1950s drought came to an abrupt end with the emergence of the 1957-8 El Niño event. Last year’s March ‘Storm of the Century’ over the Front Range was consistent with impacts expected from the El Niño of 2002-3.

Aside from La Niña, there are many other influences that contribute to widespread and prolonged drought conditions. Several important ones involve land surface feedback mechanisms: The longer a region stays dry, the more the soil dries

out, and the sun’s energy goes into heating up the atmosphere instead of evaporating moisture. During the warmer half of the year, this results in heat waves that tend to dry the soil out even further. Thus, moisture has to be imported rather than recycled to make it rain, and with growing spatial extent, this mechanism may perpetuate a drought over the interior of continents. The 1930s dustbowl years are a prime example for this. In September 2002, it took the land-falling hurricane ‘Hernan’ from the Pacific Ocean to reintroduce moisture to Colorado after a failed monsoon season.

During extreme wildfire seasons, drought gets reinforced by large-scale forest fires. They release huge amounts of soot into the atmosphere that may ‘overseed’ clouds, thus resulting in drizzle rather than regular raindrops. Suspended haze high above the ground tends to anchor temperature inversions, and reduces the sunshine reaching the ground, thus hindering thunderstorm development. Much of the Western U.S. was affected by this during the 2000 and 2002 fire seasons.

As a third feedback mechanism, late season snowpack may have an influence on the monsoon: if snow lingers into the summer, as in 1995, it appears to inhibit the development of a surface heat low, one of the key ingredients of the monsoon system. On the other hand, if an anemic snowpack melts out early, it opens the door for an early onset of the monsoon season - to the extent that it can overcome the soil moisture and forest fire impacts described above. Therefore, this mechanism may provide for an escape hatch out of prolonged drought conditions.

Other factors play a role, and are the subject of ongoing research. Oceans have been called the flywheels of the climate system by maintaining long-lasting sea surface temperature anomalies that influ-

ence the atmosphere above them. Aside from the Pacific, with its El Niño and La Niña events, anomalously warm Indian and Atlantic Oceans may be detrimental by diverting the storm track away from us. Solar influences like the 11-and 22-year sunspot cycles have been correlated with precipitation anomalies around the world, including Colorado, but as yet there is no ready physical explanation for these apparent relationships. Again, much research remains to be done.

What will the Future bring?

While there is broad scientific consensus that global warming is likely to occur over the next century, it is much less clear how this will affect the climate of any given region, including Colorado. Our climate is shaped by occasional storms that cross our region, followed by dry spells that can last for weeks. **Are the dry spells going to be more intense due to higher temperatures, while the stormy periods drop more moisture on us, as has been suggested by scientific reports?** While confidence with regard to precipitation prospects is low, most climate models suggest that Colorado’s climate will become warmer. Global warming could lead to earlier snowmelt in the mountains, and longer growing (and irrigation) seasons in the plains, translating into higher water demand. Even if we receive as much moisture as we have in the past, this may pose a challenge for Colorado’s future.

Dr. Klaus Wolter is a meteorologist at the NOAA Climate Diagnostics Center in Boulder, CO. Dr. Wolter’s recent work includes producing regional climate forecasts for the interior southwest (CO, UT, AZ and NM).

Dr. Wolter’s regional climate forecasts come out every month on the web at: <http://www.cdc.noaa.gov/people/klaus.wolter/SWcasts/>.



Temperature through 1/01/05

Sources: Western Regional Climate Center, High Plains Regional Climate Center

The entire Intermountain West region experienced above average temperatures for the month of December. Colorado averaged 5°F warmer than normal, while Utah experienced up to 8°F warmer than normal and western Wyoming had temperatures up to 10°F above normal (Figures 2a - b). December 2003 was also warmer than average, but the temperatures in 2004 surpass last year's temperatures when the greatest temperatures were only 6°F above normal (Figure 2c).

The Intermountain West and the rest of the contiguous U.S. shared a warmer than average year in 2004, according to NOAA scientists. A NOAA News Online story reported that the average temperature for the contiguous United States for 2004 (based on preliminary data) was approximately 53.5 degrees F (11.9 degrees C), which is 0.7 degrees F (0.4 degrees C) above the 1895-2003 mean. Based on data through the end of November, the mean annual temperature in two states (Washington and Oregon) is expected to be much above average, with 30 states being above average, 16 contiguous states near average and no state below the long-term mean. (Courtesy of NOAA News Online, Story 2355, 12/16/2004.)

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

Figure 2c is an experimental product from the High Plains Regional Climate Center. The data is considered provisional because it utilizes the newest data available, which is not always quality controlled.

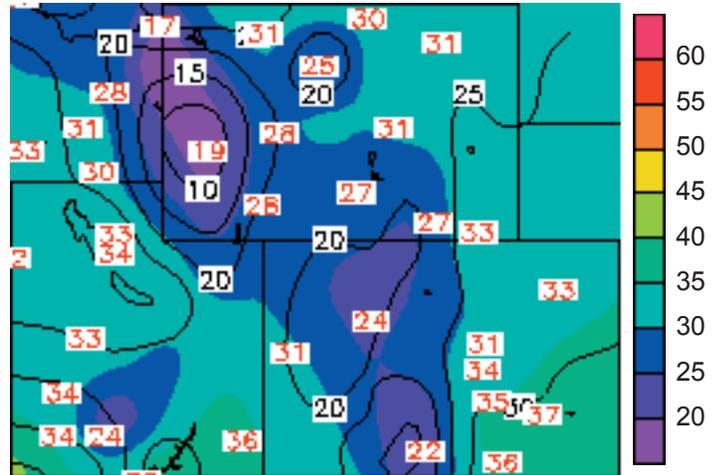


Figure 2a. Average temperature for the previous month (December 5, 2004-January 1, 2005).

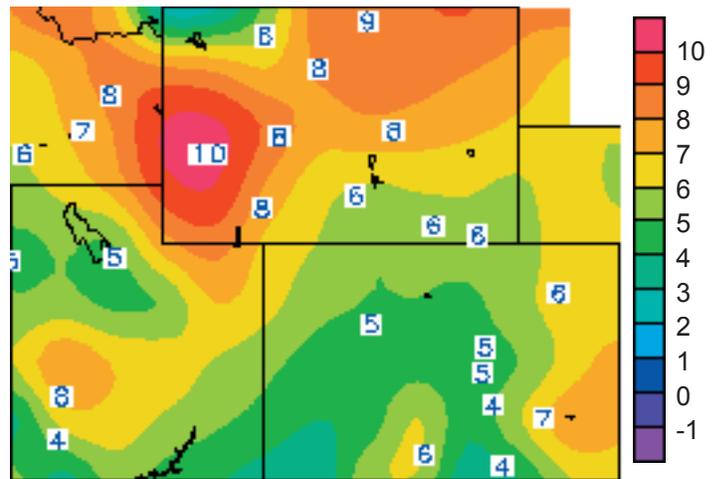


Figure 2b. Departure from average temperature for the previous month (December 5, 2004-January 1, 2005).

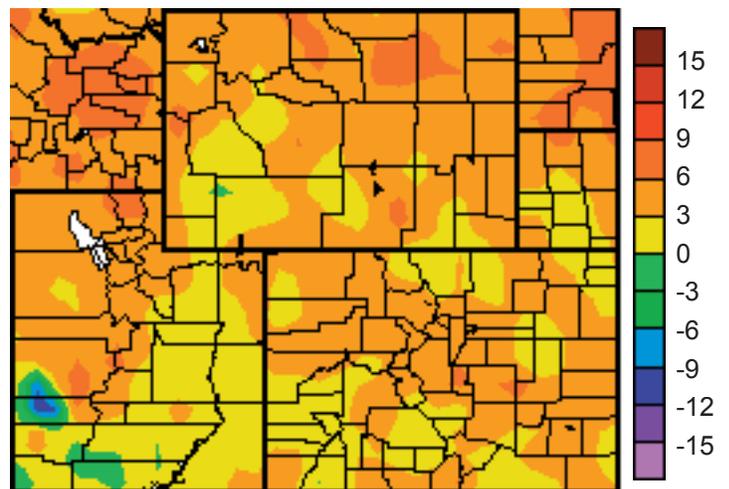


Figure 2c. Departure from average temperature for the month of December 2003.

On the Web

For the most recent versions these and maps of other climate variables including individual station data, visit: http://www.wrcc.dri.edu/recent_climate.html and <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>.

NOAA news online: www.magazine.noaa.gov/



Precipitation through 1/02/05 Sources: NOAA Climate Diagnostic Center, NOAA Climate Prediction Center

Precipitation in the Intermountain West region since the start of water year 2005 has been 150-200% above average for all of Utah and most of the western slope in Colorado. Wyoming's central mountains received up to 40% less precipitation than the 1996-2002 average (Figure 3b). The departure from average precipitation in December (Figure 3c) shows that most of Colorado and Wyoming received even less precipitation than in the previous two months of the 2005 water year. Utah fared well, keeping with the trend of receiving almost two times more precipitation than average.

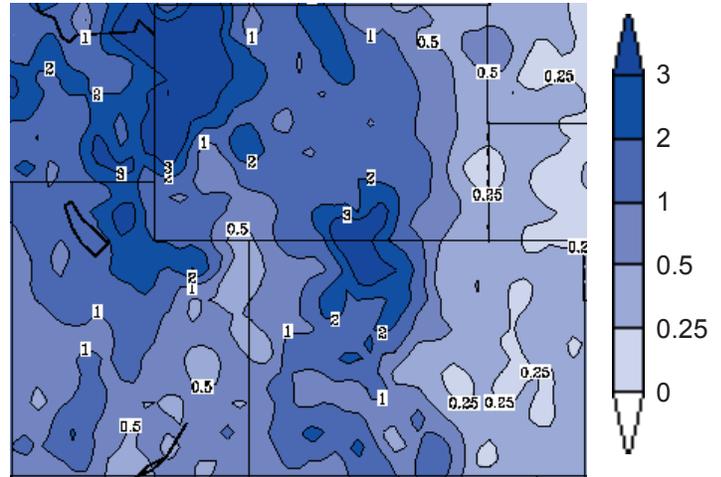


Figure 3a. Average precipitation for the previous month (December 3, 2004-January 2, 2005).

Notes

The water year begins on October 1 and ends on September 30 of the following year. As of October 1, 2004 we are in the 2005 water year. The water year is a more hydrologically sound measure of climate and hydrological activity than is the standard calendar year. It reflects the natural cycle 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 1996-2002. Percent of average precipitation is calculated by taking the ratio of current to average precipitation and multiplying by 100.

These continuous color maps are derived by taking measurements at individual meteorological stations and mathematically interpolating (estimating) values between known data points. Interpolation procedures can cause aberrant values in data-sparse regions.

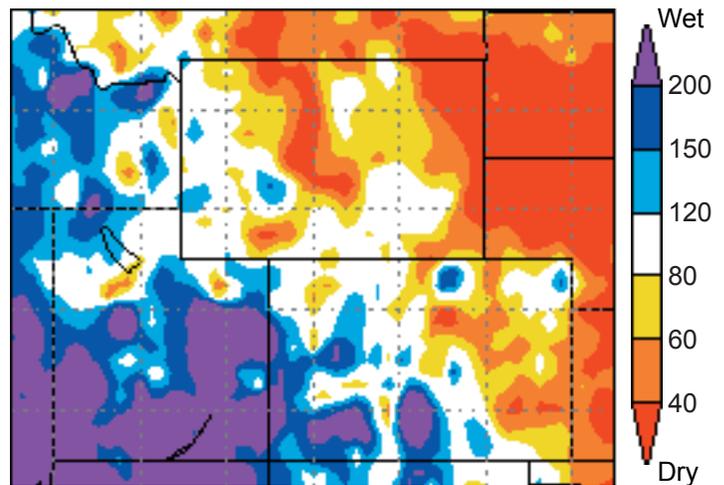


Figure 3b. Percent departure from average precipitation for the previous month (December 3, 2004-January 2, 2005).

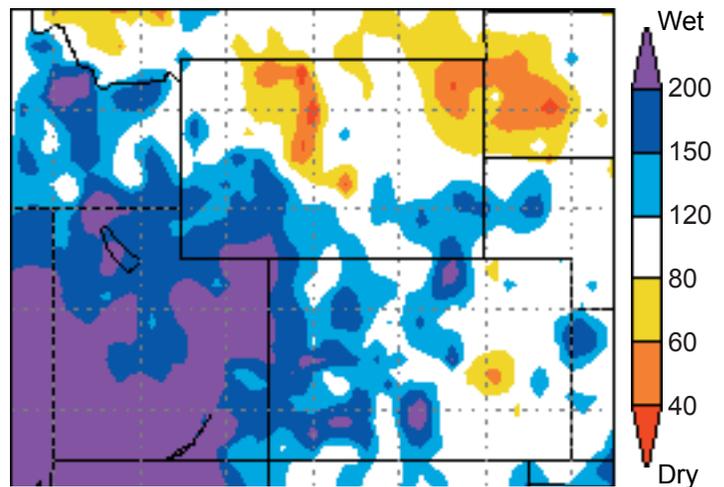


Figure 3c. Percent of average precipitation accumulated since the start of the water year (October 1, 2004- January 2, 2005).

On the Web

For these precipitation maps, which are updated daily visit: <http://www.cdc.noaa.gov/Drought/>.

For precipitation maps similar to the temperature maps on the previous page, visit <http://www.hprcc.unl.edu/products/current.html> and http://www.wrcc.dri.edu/recent_climate.html.

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 released 1/04/05

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

There has been very little change in the Interior West drought status since late November 2004 (Figure 4). Some precipitation fell in late December in parts of northern and central Wyoming, and the north-central and southwestern sections of Colorado, but had little impact on dryness and drought. Declining season-to-date precipitation totals led to deterioration to D3 in part of north-central Wyoming where late-December snow water equivalents are only about 80 to 85 percent of normal. Similarly, late-December snow water equivalents 60 to 75 percent of normal led to the reduction of D1 and D2 conditions in northwestern Wyoming to D2 or D3. In contrast, part of northeastern Utah improved from D2 to D1 because several sites reported snow water equivalent among the greatest 5% of all recorded late

December observations despite the dry week.

Notes

The U.S. Drought Monitor 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 Marc Svoboda, National Drought Mitigation Center (NDMC).

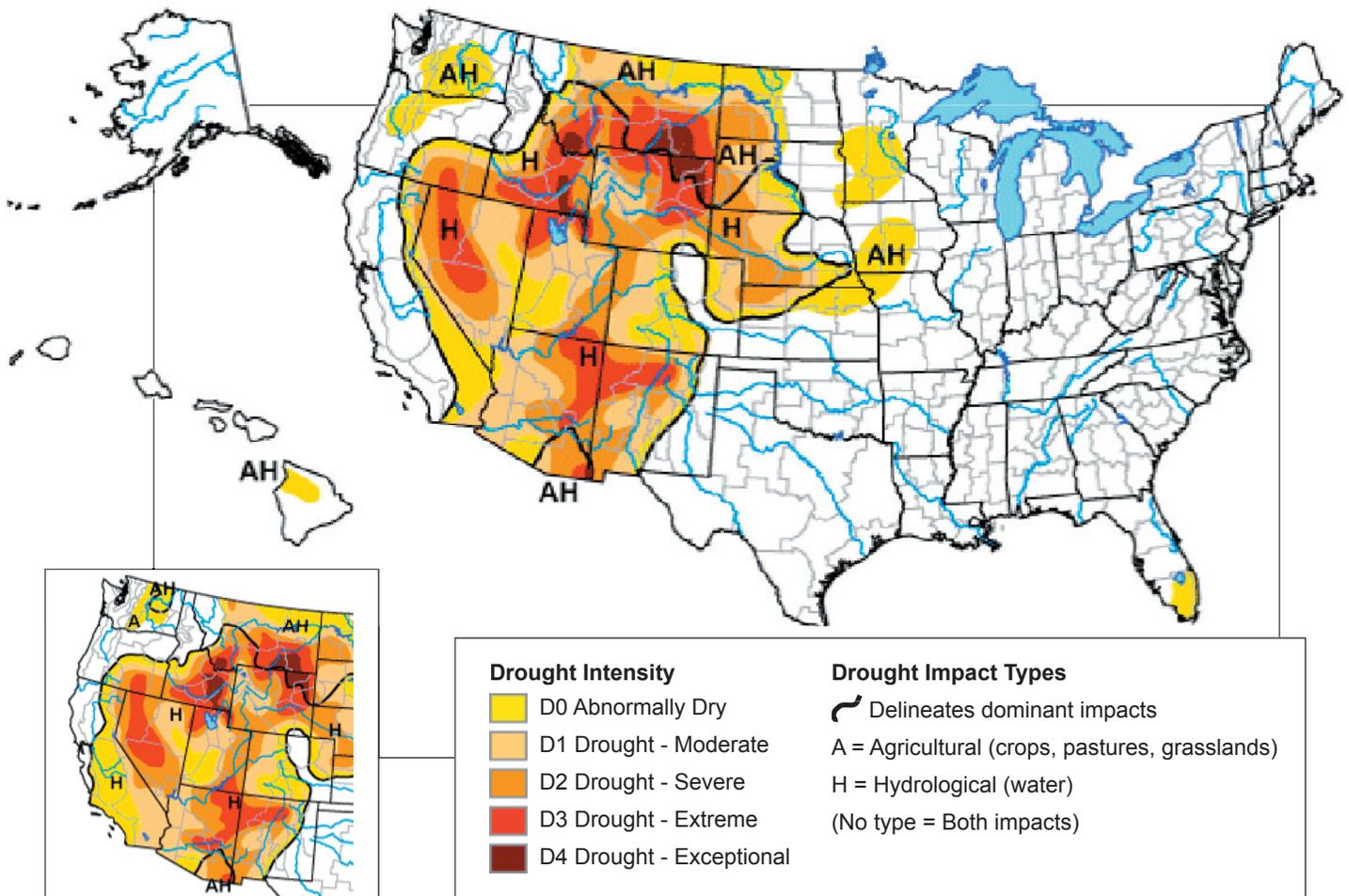


Figure 4. Drought Monitor released January 4, 2005 (full size) and last month December 7, 2004 (inset, lower left) for comparison.

On the Web

For the most recent drought monitor, visit: <http://www.drought.unl.edu/dm/monitor.html>.



Intermountain West Snowpack released 1/10/05

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

Snowpack levels are higher in much of the Intermountain west than they have been for the past several years. Utah has the most snow compared to average for this time of year with all basins above 100%, and the southwestern part of the state has above 200% of average SWE. Southern Colorado is keeping pace with Utah with snowpack levels above 100% of average. While northern Colorado has not seen as much snow as the south, the statewide total SWE is still 99% of average. Wyoming has not seen as much snow as the southern Rockies, and the weighted state average is only 87%. Continued snowfall throughout the Rockies since the beginning of January may only improve these numbers, but full drought recovery is still a long way away, especially for northern Colorado and Wyoming.

Notes

Snowpack telemetry (SNOTEL) sites are automated stations operated by NRCS that measure snowpack depth, temperature, precipitation, soil moisture content, and soil saturation. Snow water equivalent (SWE) or snow water content (SWC) is calculated from these measurements. SWE depends mainly on the density of the snow, and it refers to the depth of water that would result by melting the snowpack at the SNOTEL site. SWE is important in estimating runoff and streamflow. Given two snow samples of the same depth, heavy, wet snow will yield a greater SWE than light, powdery snow. (See page 14 for water supply forecasts.)

Figure 5 shows the SWE based on SNOTEL sites in the Intermountain West states, compared to the 1971-2000 average values. The number of SNOTEL sites varies by basin. Individual sites do not always report data due to lack of snow or instrument error.

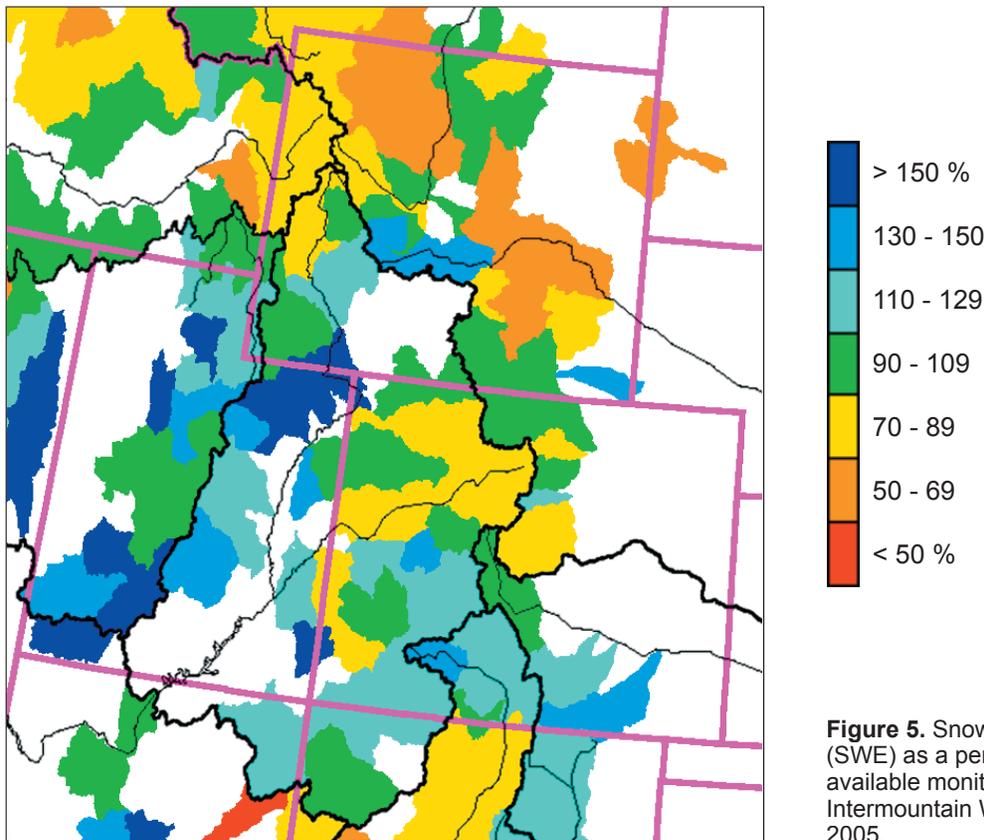


Figure 5. Snow water equivalent (SWE) as a percent of average for available monitoring sites in the Intermountain West as of January 1, 2005.

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 a list of the location of SNOTEL sites, visit: <http://www.wcc.nrcs.usda.gov/snotel/> or <http://www.wcc.nrcs.usda.gov/snowcourse/snow-course-sites.html>.

For a list of river basin snow water equivalent and precipitation: <http://www.wrcc.dri.edu/snotelanom/snotelbasin>.



Colorado Water Availability Status released 1/06/05

Source: Colorado Climate Center at Colorado State University

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 and longer-term SPIs (12 months and longer) are useful in hydrological applications. The 12-month SPI for Colorado (Figure 6a) reflects precipitation patterns over the past 12 months (Jan-Dec 2004) compared to the precipitation the same 12 consecutive months during all the previous years of available data.

In most of Colorado, the SPI is in the “near normal” category, at zero SPI (black) and above (blue-green areas). Higher positive SPIs in the northern Front Range and the southeast corner of the state (darker green shading) indicate the wet conditions that existed for this 12-month period. Some areas remain in dry conditions, including some parts of the northwestern plains, the central mountains, and the northwest (yellow shading).

The 12-month SPI is related to streamflows, reservoir levels, and even groundwater levels at the longer time scales. SPIs of

12 months and longer tend toward zero unless a specific trend is taking place, because these longer term SPIs are the cumulative result of shorter periods that may be above or below normal or near normal.

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. 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.

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, and wet periods can also be monitored using the SPI.

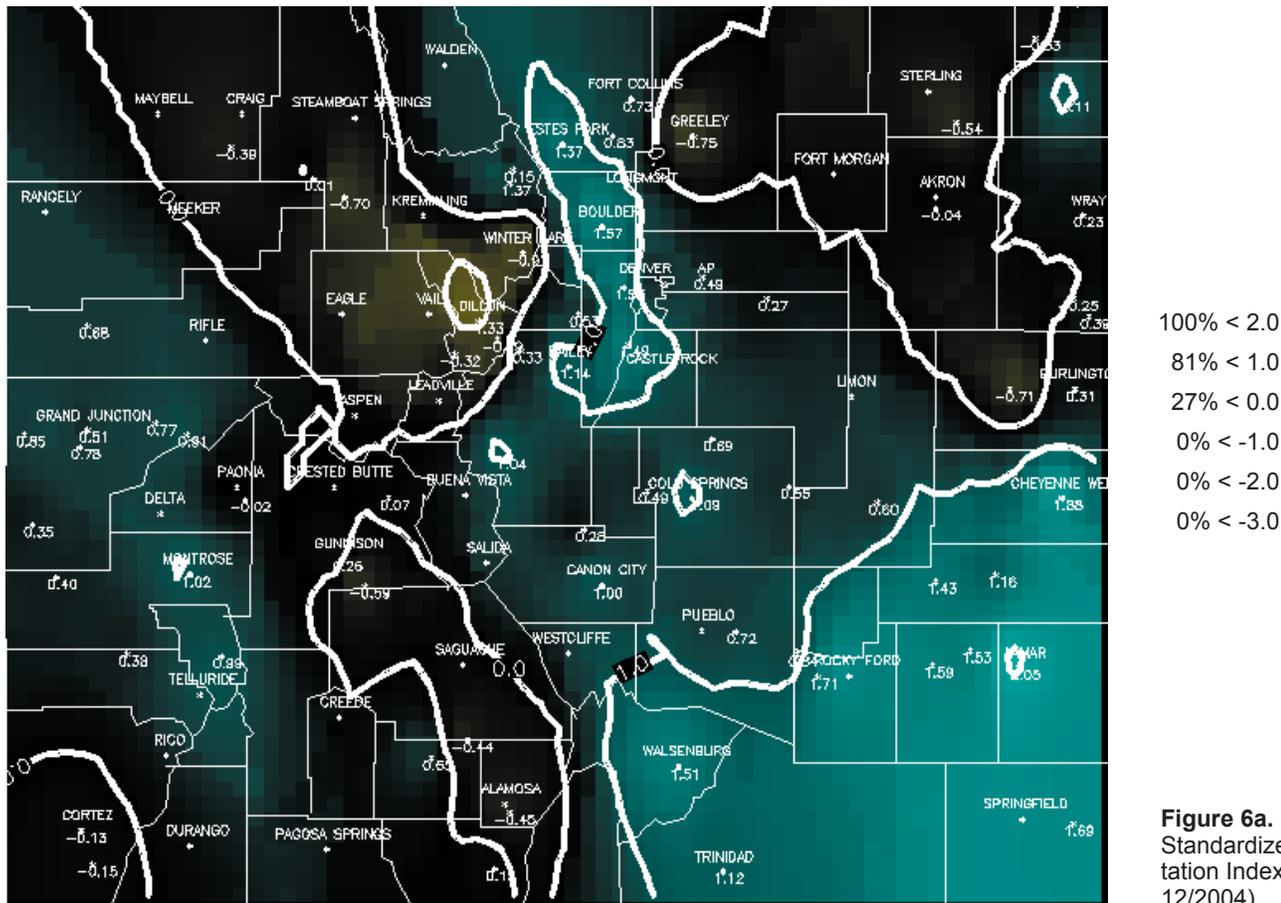


Figure 6a. 12 month Standardized Precipitation Index (released 12/2004)



Colorado Water Availability Status continued

Source: Colorado Division of Water Resources, State Engineer

None of the SWSI values are drastically high or low, indicating conditions around the state at the beginning of the year were close to normal. January 1 snowpack was below normal in the northern mountains and above normal in the southern mountains, although neither fluctuation was extreme. Cumulative storage in the reservoirs was 89% of average on January 1.

Notes

The Surface Water Supply Index (SWSI) developed by the Colorado Office of the State Engineer and the USDA Natural Resources Conservation Service is used as an indicator of mountain-based water supply conditions in the major river basins of the state. It is based on snowpack, reservoir storage, and precipitation for the winter period (November

through April). During the winter period, snowpack is the primary component in all basins except the South Platte Basin where reservoir storage is given the most weight. The SWSI values in Figure 6b were computed for each of the seven major basins in Colorado for January 1, 2005, and reflect conditions during the month of December 2004.

Surface Water Supply Index January 1, 2005

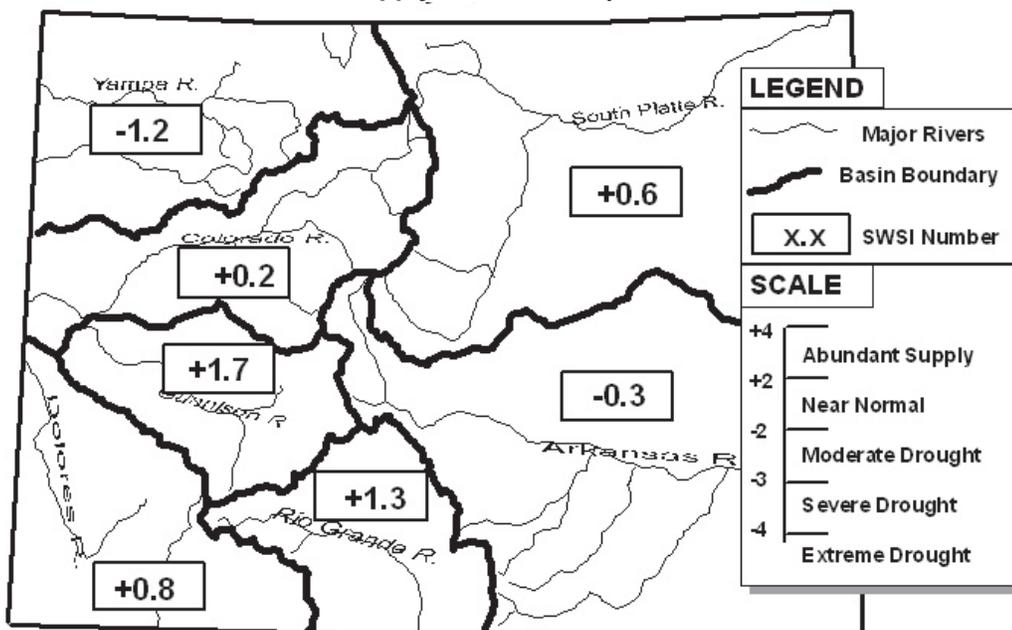


Figure 6b. Surface Water Supply Index. The map and tables show the projected streamflows by basin for spring and summer 2005, based on current conditions as of January 1. The highest SWSI values are in the southwestern part of the state. (released 1/05)

Basin	SWSI Value
Yampa, White % N. Platte	-0.5
Colorado	-0.7
Gunnison	+0.8
Arkansas	-0.7

Basin	SWSI Value
South Platte	-2.0
Rio Grande	+0.2
San Juan, Animas, Dolores and San Miguel	+1.1

On the Web

For the current SPI map and surface water projections, visit: <http://www.co.nrcs.usda.gov/snow/watersupply/>.

For maps and more information on the methodology behind SPI: <http://ulysses.colostate.edu/standardizedprecipitation.php>

For the current SWSI map, visit: <http://ccc.atmos.colostate.edu/standardizedprecipitation.php>.

The Colorado Water Availability Task Force will hold its first meeting of the year on January 18th in Boulder. Minutes of the meeting will be available at: http://www.cwcb.state.co.us/owc/Drought_Planning/Agendas/Agendas.htm



Temperature Outlook January-May 2005

Source: NOAA Climate Prediction Center

The long-lead temperature forecasts from the NOAA Climate Predictions Center (CPC) show increased chances of above-average temperatures (in the upper third of temperatures observed since 1970) for much of the western United States through May 2005, including Utah, western Wyoming and western Colorado (Figures 7 a-d). In March-May (Figures 7d), there is a slightly increased risk of below normal temperatures in much of the Great Plains including eastern Colorado and eastern Wyoming.

There is an observed trend towards higher temperatures across much of the Western U.S., and this trend is the basis for the seasonal forecast. In general, due to the strong trend the temperature forecast skill is very high and may be the most certain of all the projections for the upcoming year.

Notes

These outlooks 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 degrees of temperature.

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 3 month period is divided into 3 categories or terciles, each with a 33.3 percent 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 extremes or anomaly terciles--*above-average* (A) or *below-average* (B)--with a corresponding adjustment to the other extreme category; the near-average category is preserved at 33.3 likelihood, unless the anomaly forecast probability is very high.

Thus, using the NOAA-CPC temperature outlook, areas with light orange shading display a 33.3-39.9 percent chance of above-average, a 33.3 percent chance of near-average, and a 26.7-33.3 percent chance of below-average temperature. A shade darker orange indicates a 40.0-50.0 percent chance of above-average, a 33.3 percent chance of near-average, and a 16.7-26.6 percent chance of below-average temperature, and so on.

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.

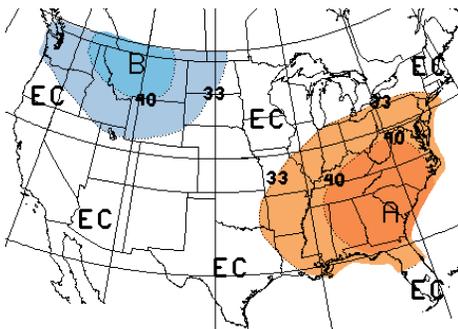


Figure 7a. Long-lead national temperature forecast for January 2005. (released December 31, 2004)

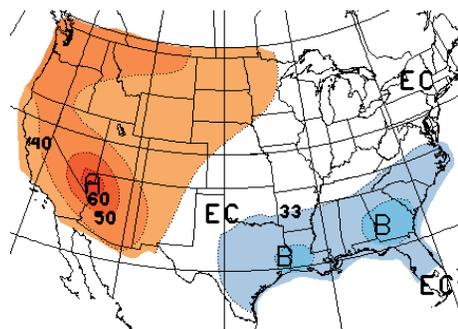


Figure 7b. Long-lead national temperature forecast for January - March 2005. (released December 16, 2004)

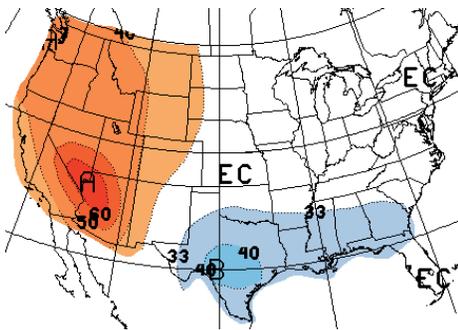


Figure 7c. Long-lead national temperature forecast for February - April 2005. (released December 16, 2004)

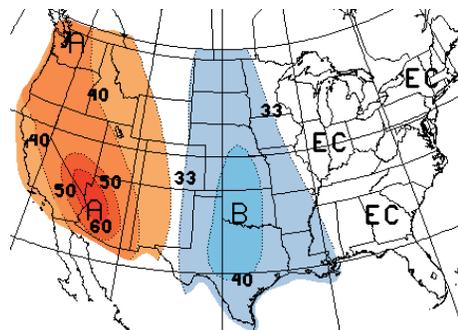


Figure 7d. Long-lead national temperature forecast for March - May 2005. (released December 16, 2004)

- 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**
No forecasted anomalies.

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.



Precipitation Outlook January-May 2005

Source: NOAA Climate Prediction Center

The long-lead precipitation forecasts from the NOAA Climate Predictions Center (CPC) predict increased chances of above-average precipitation (in the upper third of precipitation observed since 1970) through April for most of the southern tier of the United States, including parts of Colorado and Utah, and increased chances of below-average precipitation in the Northwest and from the mid-Mississippi Valley to New England (Figure 8 a-c). In March-May (Figure 8d), increased chances of wetter than-average conditions are forecasted only for the Southwest, including most of Colorado and central and southern Utah. The predictions for April-June 2005 (not shown) do not have any forecasted anomalies.

Forecast tools used by CPC, including several different climate models, are in good agreement on the main features of the precipitation forecast including enhanced likelihood of above-average precipitation from California, across the southwest and Texas, with enhanced odds of above-average precipitation retreating to mainly the southwest including parts of Utah and Colorado by March-May (Figure 8d).

Notes

These outlooks 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 3 month period is divided into 3 categories or terciles, each with a 33.3 percent 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 extremes or anomaly terciles--*above-average* (A) or *below-average* (B)--with a corresponding adjustment to the other extreme 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 percent chance of above-average, a 33.3 percent chance of near-average, and a 26.7-33.3 percent chance of below-average precipitation. A shade darker brown indicates a 40.0-50.0 percent chance of above-average, a 33.3 percent chance of near-average, and a 16.7-26.6 percent chance of below-average precipitation, and so on.

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.

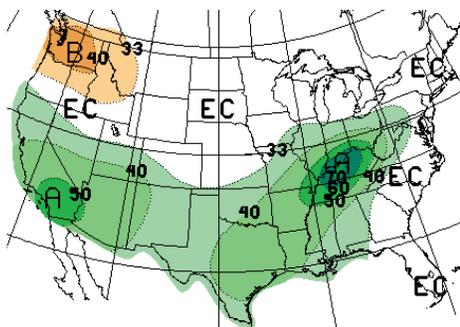


Figure 8a. Long-lead national precipitation forecast for January 2005. (released December 31, 2004)

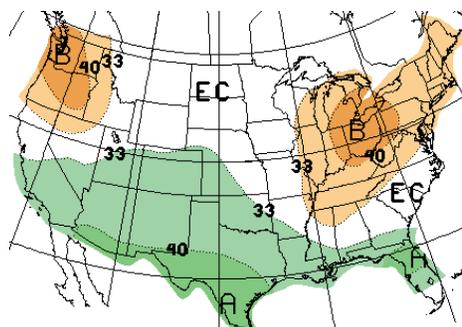


Figure 8b. Long-lead national precipitation forecast for January - March 2005. (released December 16, 2004)

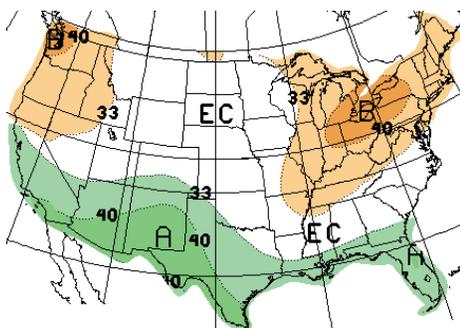


Figure 8c. Long-lead national precipitation forecast for February - April 2005. (released December 16, 2004)

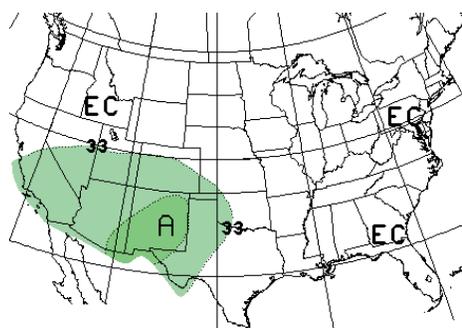
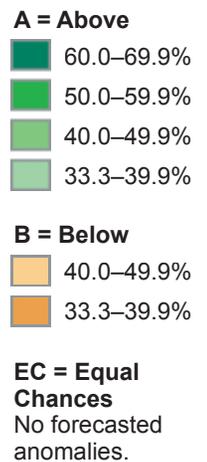


Figure 8d. Long-lead national precipitation forecast for March - May 2005. (released December 16, 2004)



On the Web

For more information visit: http://www.cpc.ncep.noaa.gov/products/predictions/multi_season/13_seasonal_outlooks/color/churchill.html. Note: this website has many graphics and may load slowly on your computer.



Seasonal Drought Outlook through March 2005 Source: NOAA Climate Prediction Center

The NOAA Climate Predictions Center (CPC) forecasts improvement in drought conditions for parts of the Intermountain West and the Southwest, and at least limited improvement for much of the western United States through March 2005 (Figure 9), although experts anticipate that large reservoirs will remain low. The pattern of expected improvement very closely follows the pattern shown on the precipitation outlook for January-March 2005 (see page 10). The only area not forecasted to improve is the northern Rocky Mountains and the northwestern Great Plains. The continuing forecast for El Niño, although weak, leads climate forecasters to believe that it will help reduce the drought. Experts believe that there is a 75 % chance that this weak El Niño will persist at least through March (page 12).

While recent precipitation is not sufficient to eliminate impacts of the drought, it has eased these impacts in some locations. According to Tom Pagano of the Natural Resources Conservation Service, soil moisture in late 2004 improved dramatically compared to the fall soil moisture present in recent years, due to exceptional rainfall in Wyoming, Arizona, Utah, and Southern Colorado in later October and early November 2004. This high soil moisture rivals levels seen during the heart of spring snowmelt season, and is now locked below the accumulating winter snowpack. The soil moisture conditions give cautious optimism for improvements in drought conditions during water year 2005, especially in Colorado and Utah.

At the recent annual meeting of the Colorado River Water Users Association, David Brandon, director of the NOAA Colorado Basin River Forecast Center, said that winter and spring snowmelt could result in twice the water flowing into Lake Powell in the spring compared to last spring (*Santa Fe New Mexican*, December 17). With current streamflows in the Colorado River higher than that seen during each of the past five years, even average winter precipitation throughout the Colorado River Basin and the resulting snowmelt and runoff may lead to at least a temporary reprieve from the dry conditions and an increase in reservoir storage. Experts continue to remind the public, however, that several years of above-average precipitation is necessary to see major improvement in large reservoirs.

Notes

The delineated areas in the Seasonal Drought Outlook (Figure 9) 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.

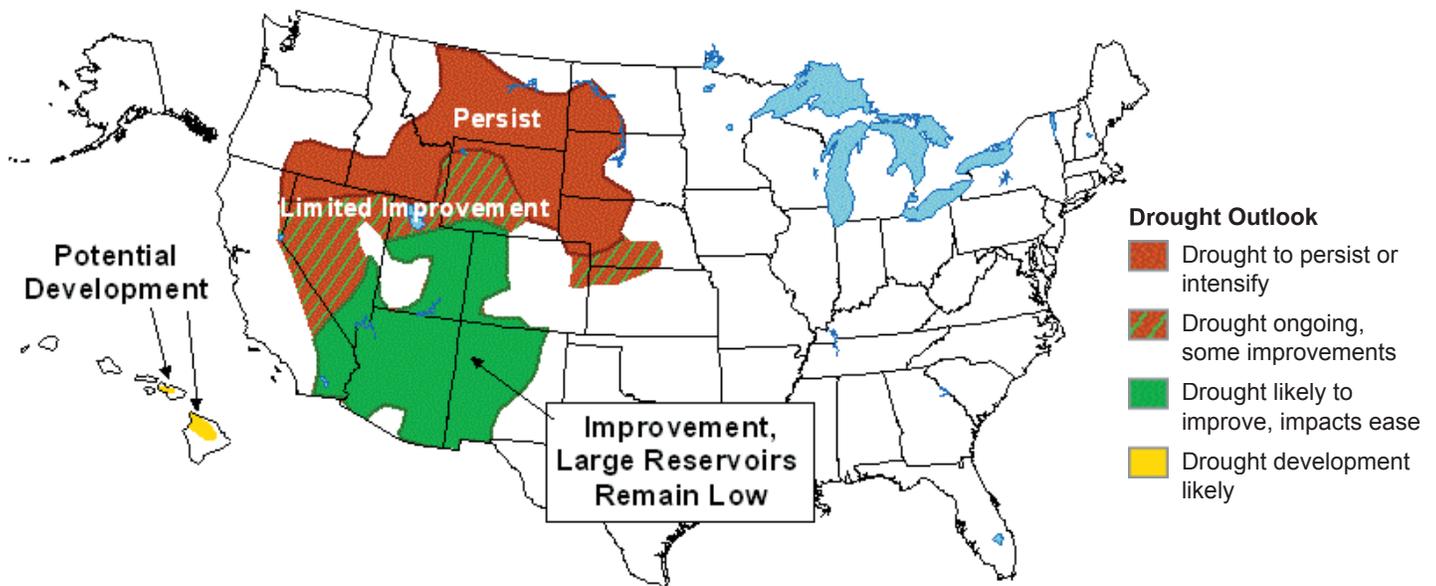


Figure 9. Seasonal Drought Outlook through March 2005 (release date December 16, 2004).

On the Web

The drought monitor is updated monthly. For the latest drought monitor, visit: <http://www.drought.noaa.gov/>.



El Niño Status and Forecast through 1/01/05

Sources: International Research Institute for Climate Prediction, NOAA/National Weather Service National Centers for Environmental Prediction, NOAA Climate Diagnostics Center

NOAA defines an El Niño as a phenomenon in the equatorial Pacific Ocean characterized by a positive sea surface temperature (SST) departure from normal (for the 1971-2000 base period), averaged over three months, greater than or equal in magnitude to 0.5°C in a region defined by 120°W-170°W and 5°N-5°S (commonly referred to as Niño 3.4). According to the NOAA Climate Diagnostics Center, positive sea surface temperature (SST) anomalies greater than +0.5°C (~1°F) persisted across most of the central and western equatorial Pacific through November 2004, and by December, positive equatorial SST anomalies greater than +1°C (~2°F) were found in some areas. The record of SST's since 1982 (Figure 10a) shows that recent SST conditions are slightly above this threshold, although this event is weak compared to the El Niño events in 1997-97 and 1983-84.

Figure 10b shows the forecasts of SST in the Niño 3.4 region, from a number of climate models run by the Federal laboratories and universities. Both dynamical and statistical models are in agreement that warm anomalies, or El Niño conditions are likely to persist through the winter and into the spring. The probabilistic El Niño-Southern Oscillation forecast from the International Research Institute for Climate Prediction (IRI) predicts an 80 percent chance that El Niño conditions will continue from December 2004-February 2005, and a 65 percent likelihood of persisting as late as March-May (not shown). Beginning in May-July, IRI and

other models suggest that neutral conditions are more likely to dominate the tropical Pacific Ocean. This trend continues through August-October.

Notes

An El Niño event is a periodic warming of surface ocean waters in the eastern tropical Pacific along with a shift in convection in the western Pacific further east than the climatological average. These conditions affect weather patterns around the world. El Niño episodes occur roughly every 4-5 years and can last up to 12-18 months.

Figure 10a shows the standardized three-month running average values of the SST anomaly for the Niño 3.4 region of the eastern tropical Pacific Ocean from January 1982 – January 2004. The SST is associated with climate effects in the Intermountain West.

Figure 10b, on the following page, shows multiple forecasts for SST in the Niño 3.4 region for nine overlapping 3-month periods from December 2004 to January 2005. 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. Thirdly, forecasts made at some times of the year generally have higher skill than forecasts made at other times of the year--namely, they are better when made between June and December than when they are made between February and May. Differences among the forecasts of the models reflect both differences in model design and actual uncertainty in the forecast of the possible future SST scenario.

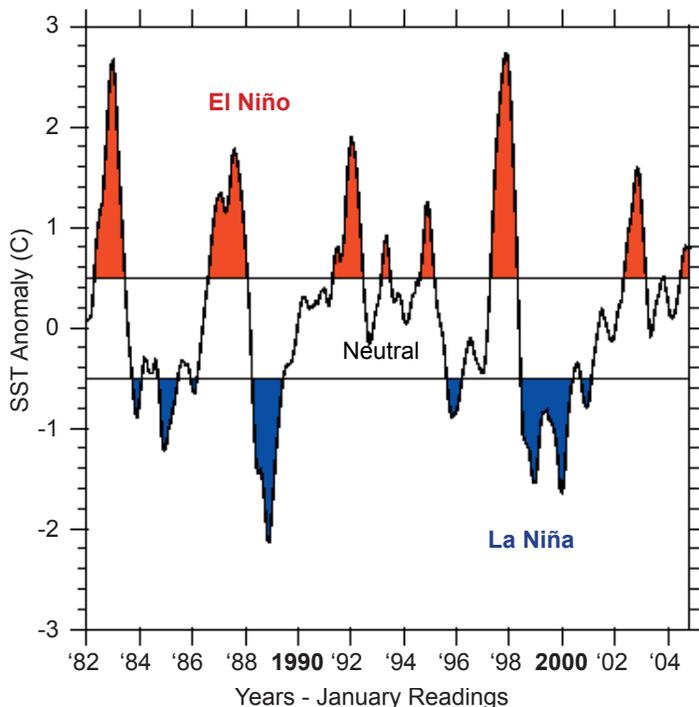


Figure 10a. The anomaly values of the sea surface temperature (SST) for the Niño 3.4 region of the Pacific Ocean from January 1982- January 2004. El Niño/La Niña occurs when the temperature anomaly (or departure from average) is greater than 0.5 (red) or less than -0.5 (blue) respectively. Values between these thresholds are normal or neutral.



El Niño Status and Forecast continued

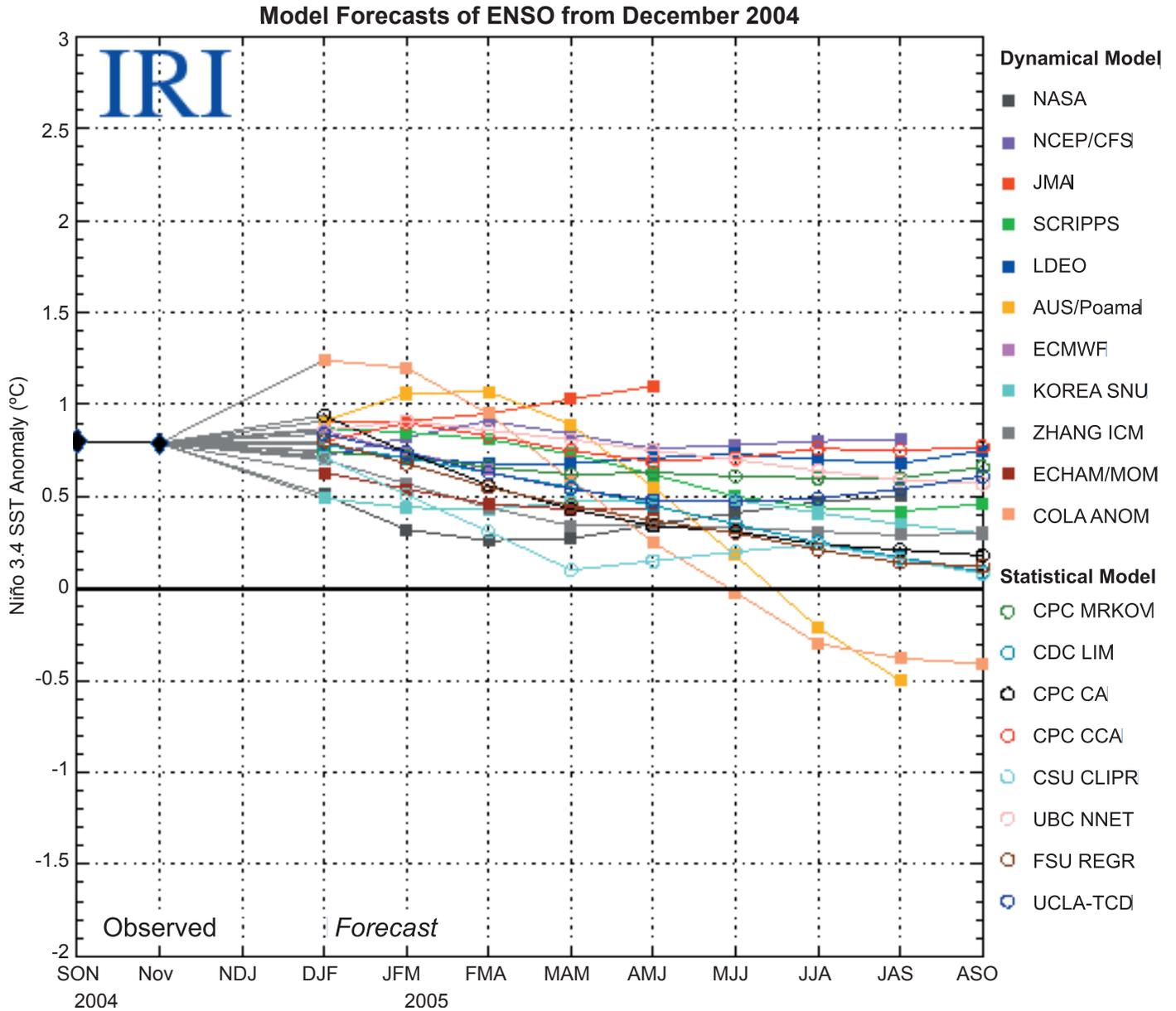


Figure 10b. Forecasts made by dynamical and statistical models for sea surface temperatures (SST) in the Niño 3.4 region for nine overlapping 3-month periods from December 2004 to October 2005. (released December 16, 2004)

“Nino 3.4” refers to the region of the equatorial Pacific from 120°W to 170°W and 5°N to 5°S which is the basis for defining ENSO sea surface temperature anomalies.

On the Web

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

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



Water Supply Forecasts released 1/04/05

Source: USDA Natural Resources Conservation Service Water and Climate Center

Streamflow projections for the Intermountain West region look better than they did last year at this time, but some basins are still projected to have below average runoff, unless they receive greater than average snowfall for the rest of winter. Specifically, the Yampa and White river basins in Colorado, the Bear River basin in Utah and the river basins in northwest and north central Wyoming are projected to have below average streamflows in the spring and summer. On the other hand, southern Colorado and most of Utah are projected to have above average streamflows with Utah's Coal Creek projection the highest at 238% of average.

The Colorado Basin River Forecast Center's (CBRFC) forecast made November 3, 2004 for Lake Powell April-July 2005

volume inflows is 6.7 million acre-feet (50% probability of exceedance), and was updated in early December to 7.3 MAF compared to an average of 7.9 MAF. (See page 15 for story.)

Notes

The forecasts of natural runoff in Figure 11 are 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.

In addition, all 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.

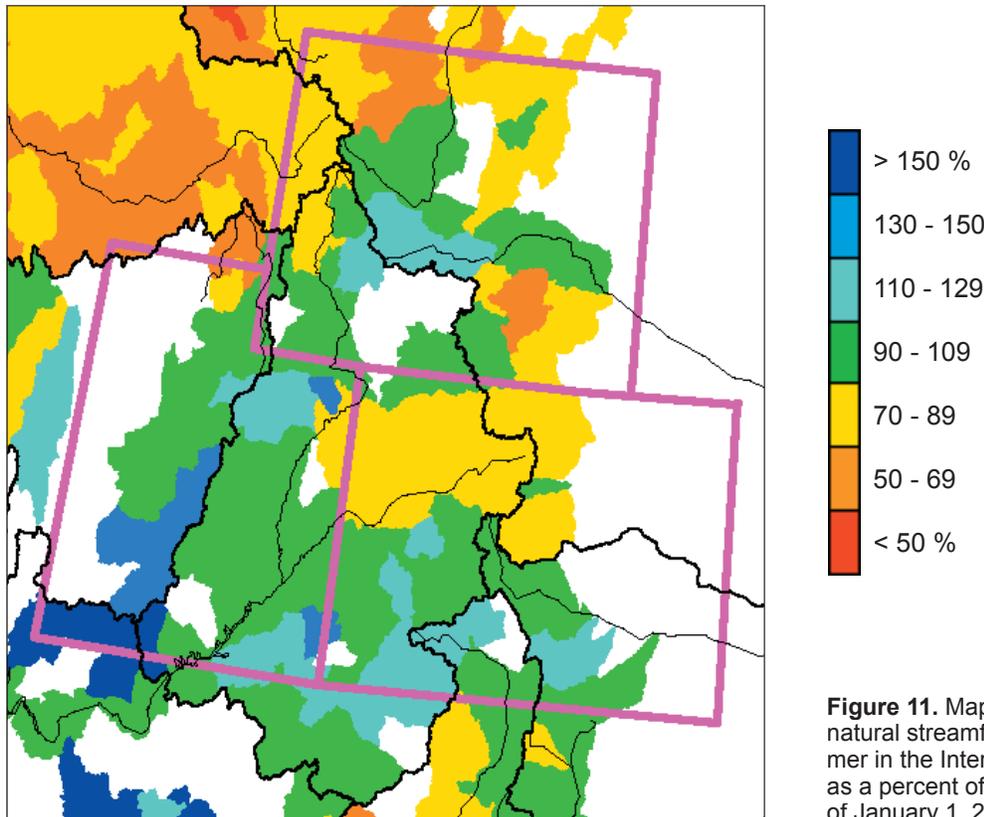


Figure 11. Map showing the expected natural streamflows for spring and summer in the Intermountain West region as a percent of average streamflows as of January 1, 2005.

On the Web

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



Colorado River Basin Water Year 2005 Outlook

Summary of a NOAA Briefing November 9, 2004



By Andrea Ray, NOAA Climate Diagnostics Center

NOAA and its climate services partners sponsored a briefing for water managers, decision makers, and planning groups in the Intermountain West region on November 9, 2004. The briefing provided an assessment of current and projected climate conditions and water availability impacting the Lower and Upper Colorado River Basins. NOAA scientists described various forecast tools available for seasonal climate and hydrologic prediction, and presented operational forecasts and outlooks. The outlook briefing was held in Salt Lake City, UT co-hosted by the NOAA Colorado Basin River Forecast Center (CBRFC) and U.S. Bureau of Reclamation (USBR) Upper Colorado Region Area Office. Over 80 people attended, including representatives of more than a dozen water resource management

organizations, several USBR offices, and several universities.

Key points of the briefing

- Soil moisture conditions in the Colorado River Basin (CRB) are considerably higher than in the fall in the past several years (Figure 11a).
- There is a weak El Niño in progress in the Pacific, not as strong as those in 1997-98 or 1982-1983, and with less pronounced effects anticipated. The center of warming directly impacting the atmosphere is located in the western Pacific, in contrast with the more canonical or typical El Niños, in which the center of warming exists in the eastern Pacific (the Niño 3.4 area).

- The long-term impact of the current El Niño on precipitation in the CRB is uncertain and highly dependent on how conditions in the equatorial Pacific evolve over the next few months.
- The early outlook for Lake Powell April-July 2005 inflows is 6.7 million acre-feet (MAF) and was updated in early December to 7.3 MAF compared to an average of 7.9 MAF (Figure 11b).
- In the short term, atmospheric circulation has shifted from the dominant winter pattern of the last few years characterized by a persistent high pressure anomaly over much of the western U.S. that was blocking moisture and storms from bringing needed drought relief. This year, however, the atmosphere

State of Utah NRCS Soil Moisture 2002-2004 (70 sites)

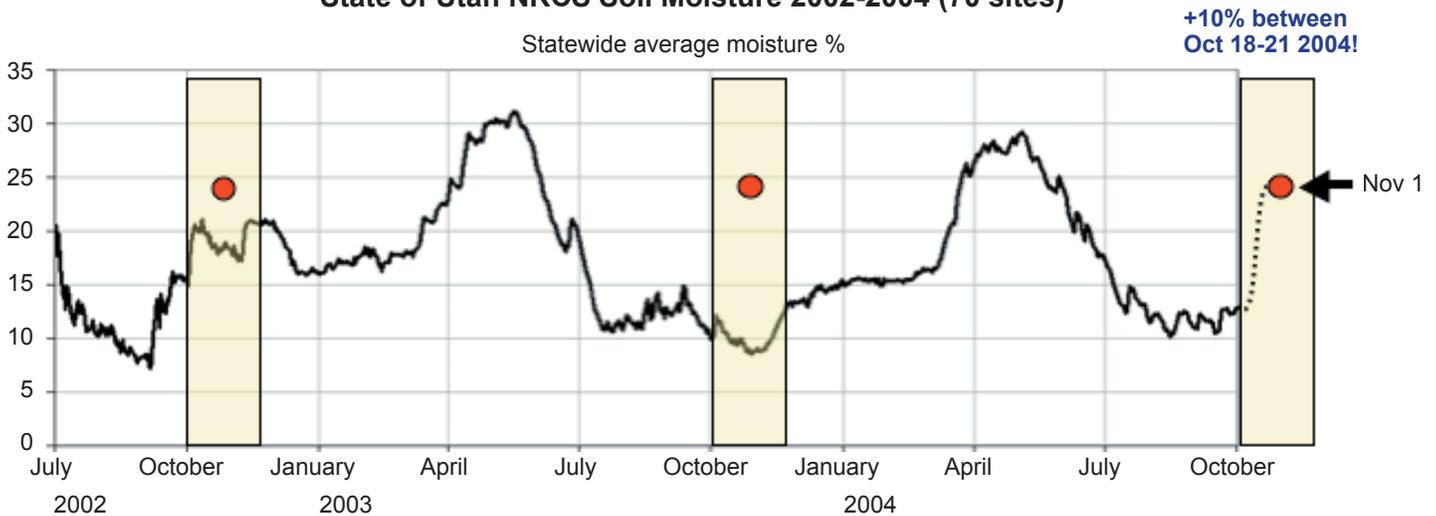


Figure 12a. Utah statewide average soil moisture percentage for July 2002 – October 2004. Note that the soil moisture for October 2004 is higher than in October 2002 and 2003 and is closer to the soil moisture in the spring runoff season. This data comes from the Utah office of the Natural Resources Conservation Service.



has been much more conducive to the production of winter storms in the CRB.

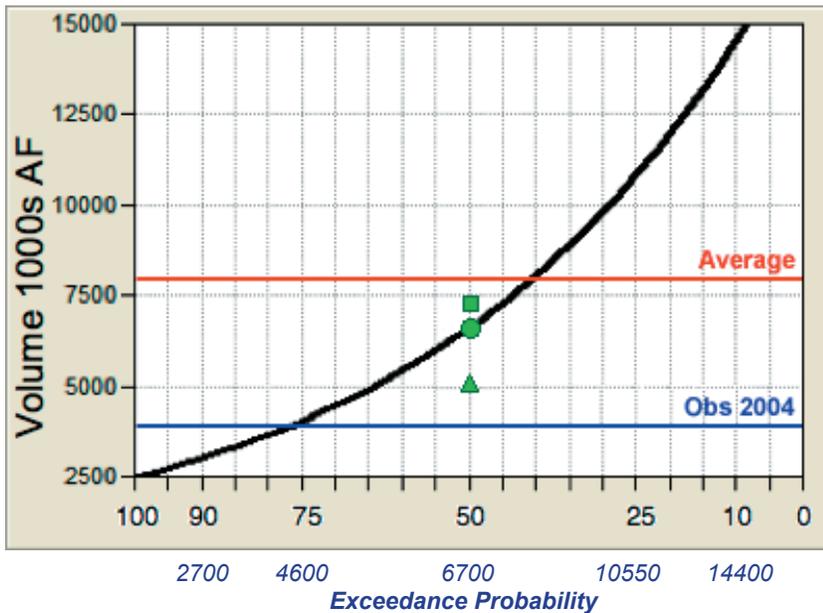
- The observed trend towards higher temperatures across much of the Western U.S., and in the CRB, may be the most certain information available about the upcoming year. Projections for the current warming trend to continue represents a potentially big challenge for water management in the CRB.
- Forecast skill for the next few seasons to a year is primarily based on the El Niño/Southern Oscillation; while there is interest by researchers in other indices such as the Atlantic Multi-decadal Oscillation (AMO) and Pacific Decadal Oscillation (PDO), there is no convincing demonstration of skill based on any index but ENSO.

- NOAA is developing new, spatially coherent climate divisions to more accurately describe, monitor, and potentially forecast sub-basin variations in climate variability.

Forecasters must combine many factors and indices in order to determine the spring and summer water supplies for the western U.S, and as these indices change, the forecast may change as well. According to the NOAA Colorado Basin River Forecast Center, the primary drivers of the water supply forecast at this time of year are antecedent fall flow; soil moisture surplus or deficit; and snowpack. Snowpack for the winter is highly uncertain and it is sensitive to details of the El Niño event, specifically the strength and the spatial pattern of the sea surface warming. Currently, there is considerable uncertainty

regarding the strength and spatial pattern for this event, which lowers the confidence in a prediction of a wet water year for the Upper and Lower Colorado Basins that forecasters would typically expect from an El Niño. However, the odds favor some overall improvement in the Basin this season based on early trends and the developing El Niño.

Dr. Andrea Ray is a research scientist at the NOAA Climate Diagnostics Center. Her recent work includes studying the interaction of climate variability and reservoir management and other studies of climate and society interactions.



Forecasts of Most Probable made on ...

- December 13, 2004 (7300)
- November 3, 2004 (6700)
- ▲ August 18, 2004 (5100)

Figure 12b. Colorado Basin River Forecast Center (CBRFC) Extended Streamflow Prediction (ESP) Forecast for Lake Powell April-July 2005 volume. The red line shows the average inflows (7.9 MAF), the blue line shows the observed inflows in water year 2004 (3.6 MAF). The black curve shows exceedance probabilities for inflows, which were calculated on November 3, 2004. The most probable inflows (50% exceedance) forecast on that date was 6.7 MAF. However, that value was revised up to 7.3 MAF in December due to favorable soil moisture and precipitation.

For more information on streamflow forecasts, visit the CBRFC web site, www.cbrfc.noaa.gov, and go to 'Water Supply Forecasts'.

On the Web

Agenda, meeting summary, and complete presentations are available at: <http://www.cdc.noaa.gov/news/crbob>.

