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INTERMOUNTAIN WEST CLIMATE SUMMARY

A product of the Western Water Assessment

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Brad Udall – WWA Director

Jeff Lukas, Eric Gordon, Heather Glenn, Kristen Averyt, Tim Bardsley – Editors/Writers

Heather Glenn – Graphic Designer

Klaus Wolter, Gary Bates – Asst. Editors

January 2011 Summary

Temperature & Precipitation —*December was unusually warm across the region, and unusually wet in Utah and most of southern Wyoming and western Colorado, as strong westerly and southwesterly flow moderated the temperatures and brought abundant moisture. Eastern Colorado remained on the dry side.*

Hydrological Conditions — *With the abundant December moisture, mountain snowpacks in nearly all basins across the region were above-average at the end of 2010, and the January 1 streamflow forecasts for spring and summer runoff reflect the generally high snowpack levels.*

ENSO — *Borderline strong La Niña conditions have continued into mid-winter, and the current La Niña event is forecasted to persist through Spring 2011, though with weakening expected.*

Climate Forecasts — *Given the La Niña conditions, much of the Intermountain West is forecasted to have an enhanced risk of above-average temperatures and below-average precipitation through Spring 2011.*

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Announcements & News

WWA welcomes new Utah Liaison

Last month, our capacity to work with stakeholders in Utah was greatly enhanced as Tim Bardsley came on board as the WWA Utah Liaison. Tim was most recently a hydrologist with the NRCS Utah Snow Survey, since 2002. His WWA office is in Salt Lake City, hosted by our NOAA colleagues at the NWS Colorado Basin River Forecast Center (CBRFC). Tim's primary task to start with will be to meet with resource managers and other stakeholders in water, agriculture, recreation, wildlife and forestry, and other sectors to better understand their needs for climate information and to connect them to the research and resources of WWA and its partners. He is excited to interact with users of climate information across Utah. Tim's email is wwa.bardsley@gmail.com.

WWA seeks candidates for Wyoming Liaison

We are still looking for the right person to expand our capacity to serve stakeholders in Wyoming. The Wyoming Liaison position will be hired through the University of Colorado but hosted by the University of Wyoming in Laramie. For a full job description and desired qualifications, see here: http://cires.colorado.edu/jobs/WWA-7.pdf

WWA-CBRFC Streamflow Forecast Workshop

March 15, 2011, St. George, UT

WWA and the NOAA NWS Colorado Basin River Forecast Center (CBRFC) are presenting a half-day workshop in St. George, Utah, for current and potential users of NOAA/NWS online streamflow and hydrometeorology resources. These resources include, but are not limited to: capabilities for accessing and analyzing streamflow forecasts, water supply forecasts, peak flow forecasts, snow information, precipitation analysis, and weather forecasts. The workshop sessions are designed to both educate participants about the tools and the forecasts, and solicit feedback to improve the tools. The workshop will be part of the program of the Utah Water Users Workshop, which runs from March 14-16 in St. George.

For more information and to register, please visit the workshop webpage here. The Colorado Basin River Forecast Center web resources can be accessed here.

WWA-CBRFC Streamflow Forecast Workshop
June 2011, Salt Lake City, UT

WWA and the CBRFC will also be presenting an all-day workshop in June in Salt Lake City for current and potential users of NOAA/NWS online streamflow and hydrometeorology resources. The tentative workshop date is June 14, 2011. For more information about the workshop, please contact Tim Bardsley at wwa.bardsley@gmail.com.

NOAA's new Regional Climate Service Directors

In September 2010, NOAA announced the hiring of six regional climate services directors, to be co-located with the six regional National Weather Service offices around the country. The directors will work and collaborate with regional partners from other federal agencies, state, local and tribal governments, universities, the private sector, and non-governmental organizations, and also integrate the work of various NOAA partners engaged in developing and delivering climate science and services at the regional level**,** including the RISA programs such as WWA. The WWA region is covered by two regional climate services directors: DeWayne Cecil will serve Utah and other Western Region states from his Salt Lake City office, and Doug Kluck will serve Wyoming, Colorado, and other Central Region states from his Kansas City office.

Special feature in PNAS on Climate Change and Water in the Southwest

Last month, the journal *Proceedings of the National Academy of Sciences* (PNAS) published a special feature on "Climate Change and Water in Southwestern North America." The eight papers include treatments of water sustainability challenges, including urban water shortage, and assessments of the current drought and the projections of the rest of this century's climate, and observed and future climate impacts on hydrology and forest ecosystems. Many researchers from WWA's sister programs, Climate Assessment for the Southwest (CLIMAS), and the California-Nevada Applications Program (CNAP), contributed to the papers. The eight papers are freely available from PNAS: http://www.pnas.org/cgi/collection/climate_change_sw

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Feature Article

Dust-on-snow and hydrologic impacts in the Colorado River Basin

Jeff Deems, Western Water Assessment and National Snow and Ice Data Center, and Jeff Lukas,Western Water Assessment

(download pdf)

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Focus Article

There is no Focus Article this month.

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Recent Climate Conditions

Average temperatures for December ranged from below 20°F in high-elevation mountain regions of central **Colorado** and northwestern **Wyoming** to up to 40°F across southern **Utah** and southeastern **Colorado** (Figure RC-1). Temperatures across the region were substantially warmer than average during December, with the most of western **Colorado** from 6° to 15°F above average, and departures of 3° to 6°F above average across nearly all of the rest of **Colorado, Wyoming** and **Utah**. (Figure RC-2).

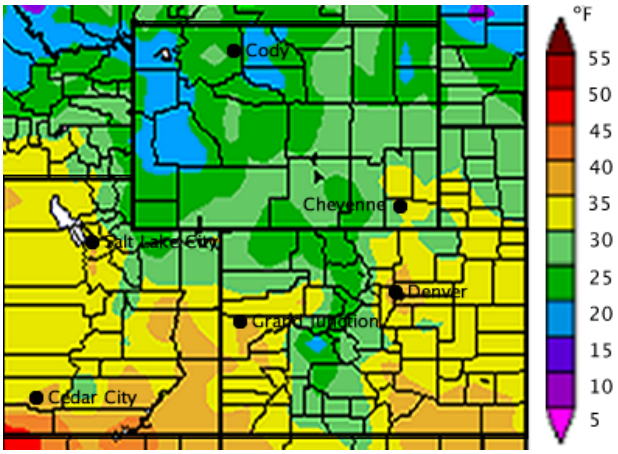

Figure RC-1. Average temperature for the month of December 2010 in °F. (Source: High Plains Regional Climate Center)

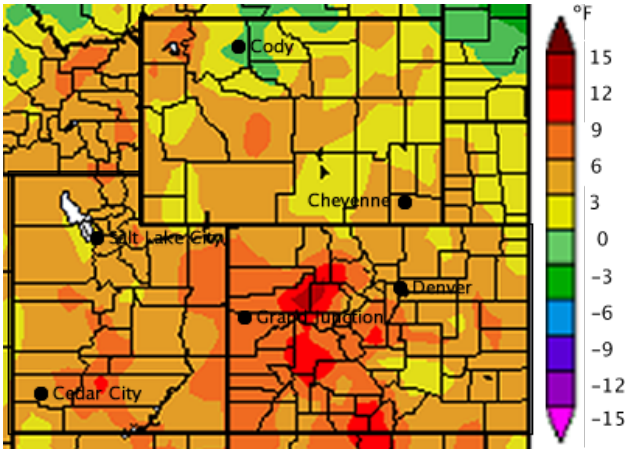

Figure RC-2. Departure from average temperature for the month of December 2010 in °F. (Source: High Plains Regional Climate Center)

A persistently strong Pacific jet stream during December brought multiple storm systems and copious moisture to the western half the region (Figure RC-3). Almost all of **Utah**, and most of southern **Wyoming** and western **Colorado** received over 200% of average precipitation for the month (Figure RC-4). Much of eastern **Colorado** and northern **Wyoming**, on the other hand, failed to benefit from these storms, ending the month with below-average precipitation.

December's wet-west/dry-east moisture pattern also dominates the precipitation picture for the 2011 water-year-to-date (Figure RC-4b). Nearly all of **Utah** and most of southern **Wyoming** and western **Colorado** received over 150% of average precipitation for the October–December period, while southeastern Colorado and parts of northeastern Wyoming received less than 50% of average precipitation during the same period.

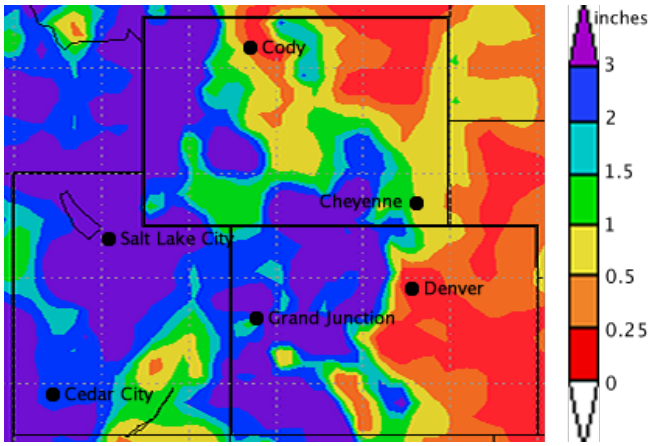

Figure RC-3. Precipitation for the month of December 2010 (inches). (Source: NOAA ESRL Physical Science Division)

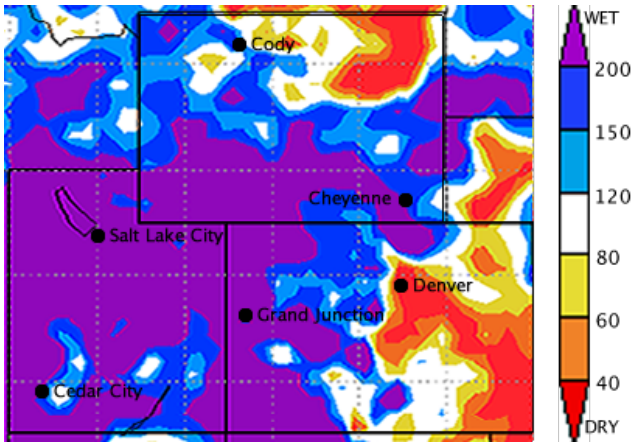

Figure RC-4. Precipitation for the month of December 2010 as percent of average precipitation for December. (Source: NOAA ESRL Physical Science Division)

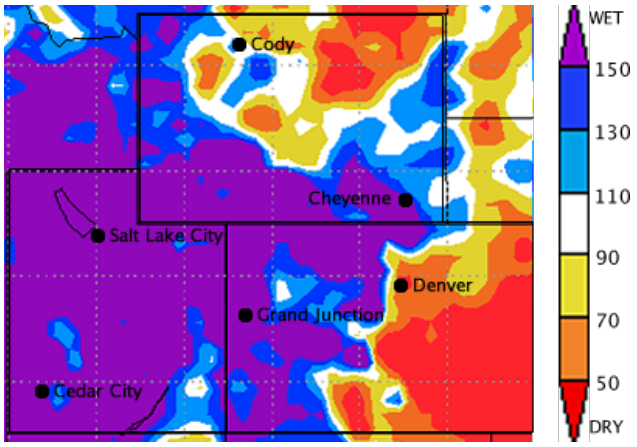

Figure RC-4b. Precipitation for water year 2011 to-date (October–December 2010) as percent of average precipitation for October–December. (Source: NOAA ESRL Physical Science Division)

The 3-month SPI (Figure RC-5) shows moderately to extremely wet conditions across all of **Utah**, particularly in the southwest corner of the state. Western **Colorado** and portions of western **Wyoming** are moderately wet, while most of the other climate divisions in the region are near normal. Southeastern **Colorado** experienced very dry conditions during the three-month period. The 36-month SPI (Figure RC-6) shows near-normal conditions throughout much of the three-state region, with moderately dry conditions in northwestern **Wyoming** and south-central **Colorado**.

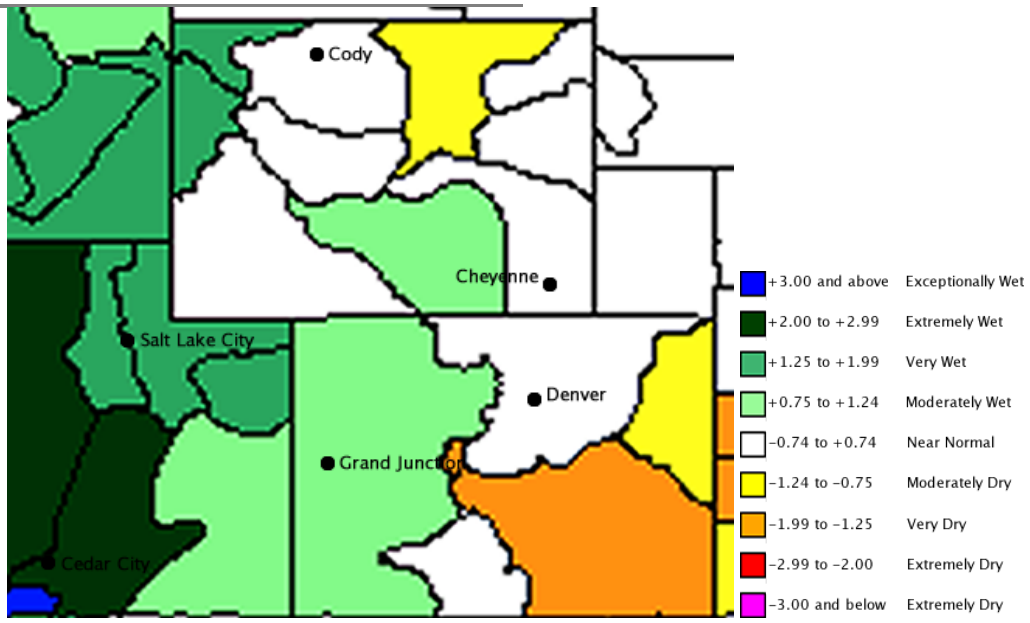

Figure RC-5. 3-month Intermountain West regional Standardized Precipitation Index as of the end of December 2010 (data from 10/01/10–12/31/10). (Source: Western Regional Climate Center)

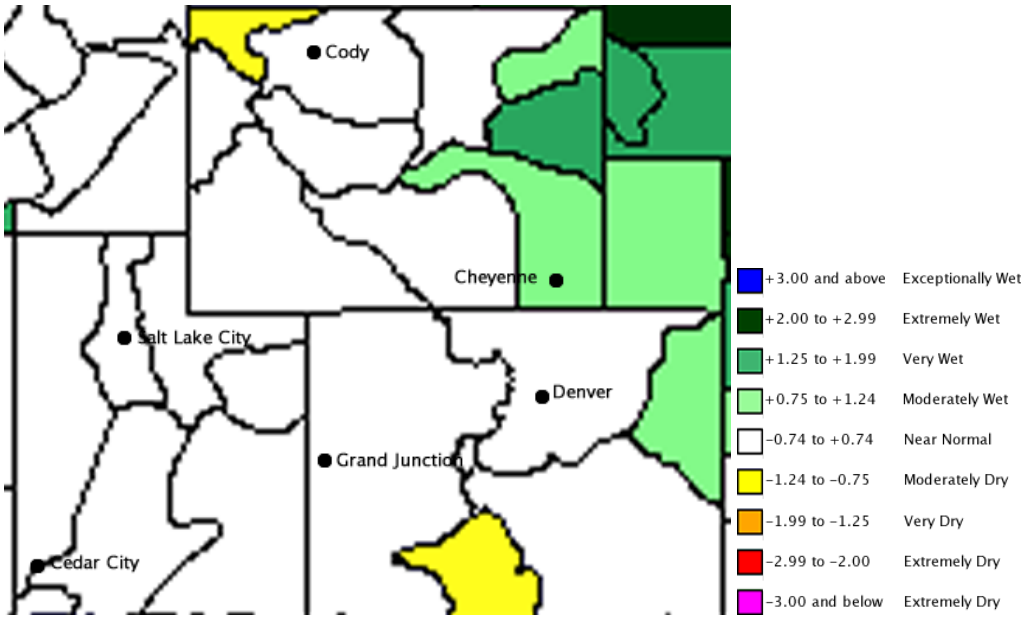

Figure RC-6. 36-month Intermountain West regional Standardized Precipitation Index as of the end of December 2009 (data from 1/01/08–12/31/10). (Source: Western Regional Climate Center)

The U.S. Drought Monitor issued January 18 indicates that moderate to severe drought conditions are persisting across nearly all of eastern **Colorado**. Western **Wyoming** remains abnormally dry, while the remainder of the three-state region is not experiencing drought conditions (Figure RC-7).

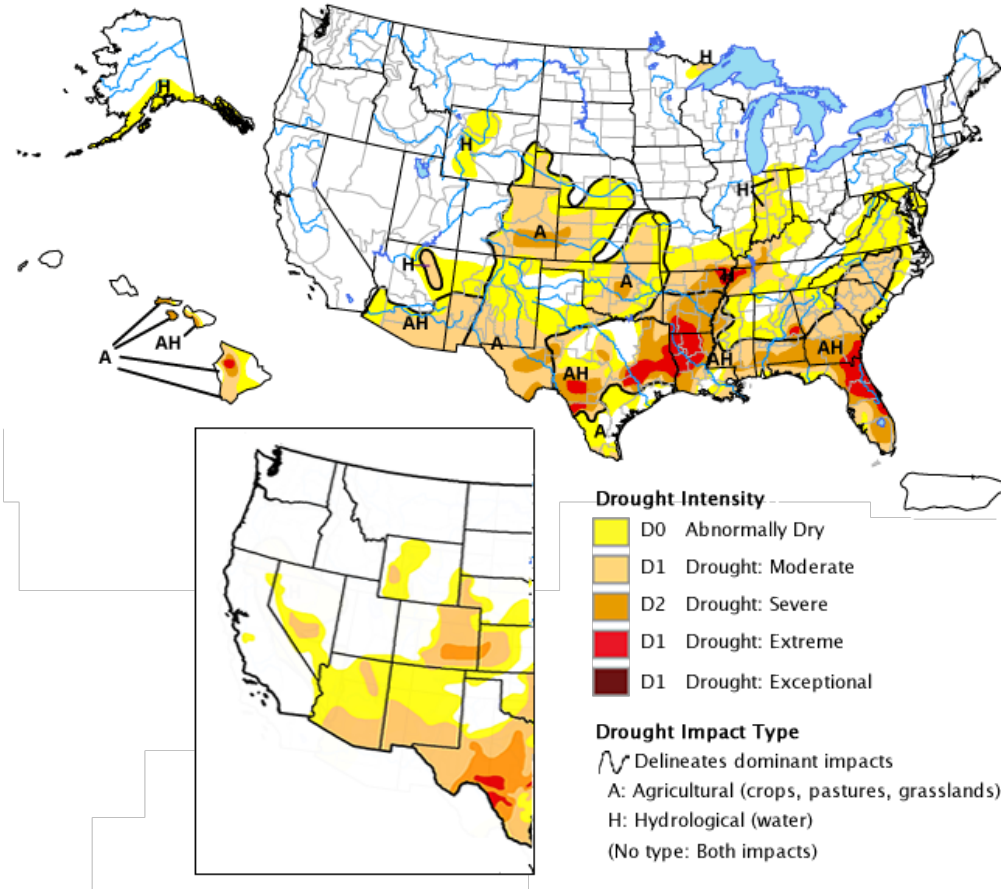

Figure RC-7. U.S. Drought Monitor from January 18, 2011 (full size) and December 21, 2010 (inset, lower left) for comparison. (Source: National Drought Mitigation Center)

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Intermountain West Snowpack

The 2011 water year got off to a solid start, with January 1 snowpacks at near average to well above average throughout the region. Nearly all basins have larger snowpacks than at this time in the past few years, and in some areas, one has to go back to 1997 or earlier to find wetter early-season conditions. These favorable conditions are in large part due to a wet December throughout the region. As a result, January 1 SWE (Snow Water Equivalent) across the Intermountain West was above average in most basins (Figure SP-1). It is important to remember that most of the snow accumulation season still lies ahead.

In **Colorado**, January 1 snowpacks were above average in all basins. Statewide, water-year precipitation and snowpack have been above average for most of the state since the onset of snow accumulation, with the exception of the Arkansas basin, and the southwest region. This latter area caught up to and surpassed average conditions during the second half of December, leading to a statewide snowpack of 136% of average as of January 1. Basinwide percentages ranged from a low of 105% of average in the Arkansas to 158% of average in the Gunnison (Figure SP-1).

Utah statewide snowpack was the highest in the three-state region, and the highest January 1 snowpack since 1984. New records for January 1 SWE were set at 18 SNOTEL sites with periods of record in excess of 20 years. Precipitation in Utah was above average in all basins for October, November and December. Seasonal (October–December) precipitation statewide was 197% on January 1, ranging from a low of 154% for the Upper Green River in Utah, to 349% for the Virgin River. Southwestern Utah experienced significant flooding in late December as a result of an intense "Pineapple Express" storm. January 1 statewide average snowpack was 193%, ranging from 131% in the Escalante to 315% in the Virgin (Figure SP-1). The Uinta Mountains had the largest January 1 SWE since SNOTEL Measurements began in the late 1970s.

Wyoming snowpacks were above average in most basins, and slightly below average in the northeast basins as of January 1, with a statewide average of 118%. Individual basins ranged from 87% in the Belle Fourche and Cheyenne to 155% in the Upper North Platte (Figure SP-1). December precipitation ranged from 107% to 178%, bringing year-to-date precipitation to 100% to 173%. While these numbers are not quite as impressive as those in Utah and Colorado, they still represent the deepest January 1 snowpacks that many basins in Wyoming have seen for over a decade.

Snowpack Update, January 20: Snowpack conditions have changed considerably in the three-state region since January 1st, particularly in much of **Utah**, and southwestern **Colorado**, where conditions have been very dry for the past three weeks. While snowpacks in this region have not lost snow, the lack of significant accumulation during this period has brought basin percent-of-average down considerably. The most dramatic example is the Virgin River, where snowpack has gone from 315% on January 1 to 212% on January 20. Northeastern **Wyoming** and northeastern **Colorado**, conversely, have seen gains in snowpack percent-of-average as they received above-average precipitation during this period. Most of the rest of the region has seen moderate decreases in percent of average SWE-to-date since January 1.

[Much of the text in this section comes from the NRCS State Basin Outlook Reports: http://www.wcc.nrcs.usda.gov/cgibin/bor.pl.]

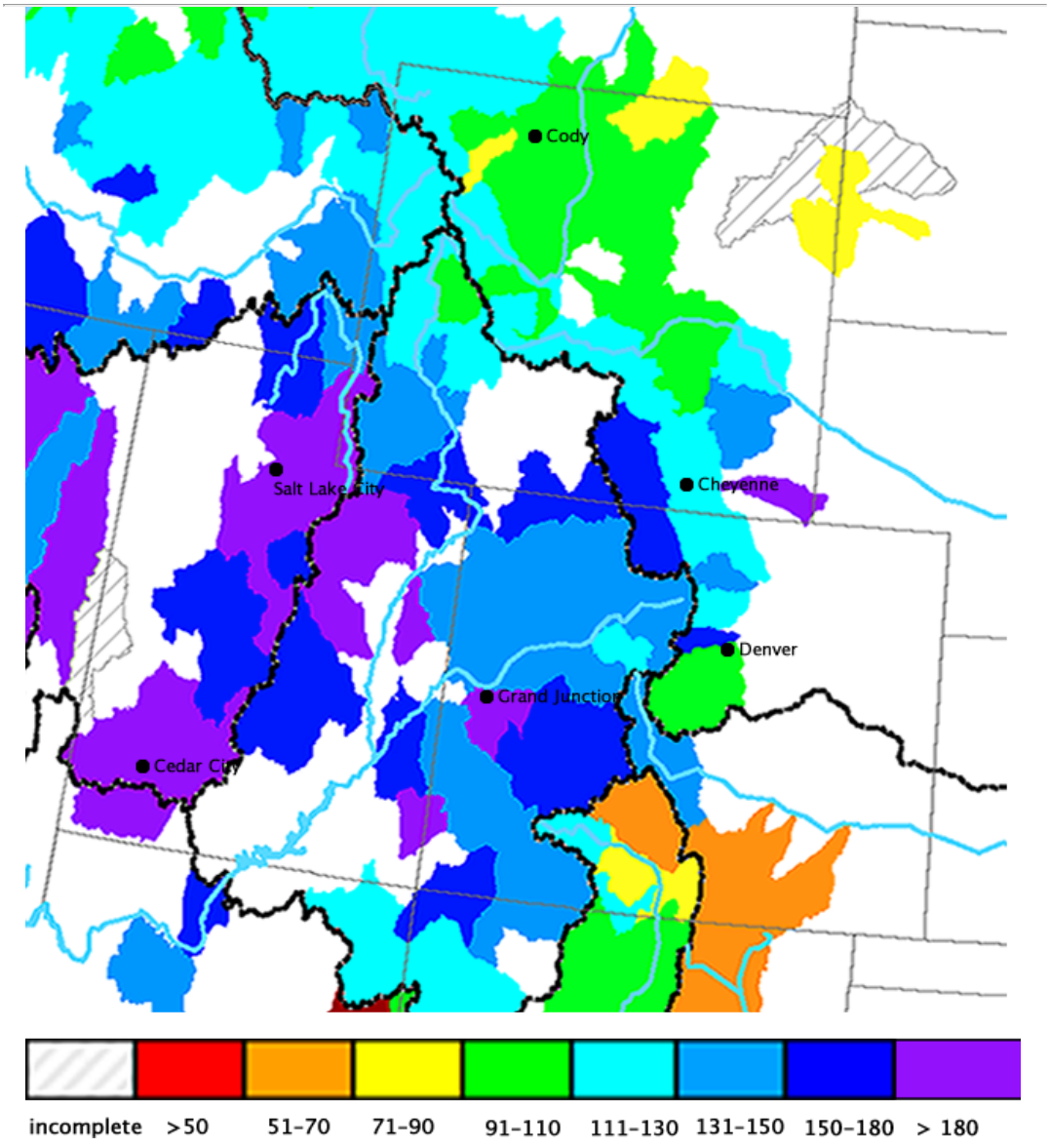

Figure SP-1. Snow water equivalent (SWE) as a percent of average for available SNOTEL and snow course sites, averaged across each basin, in the Intermountain West as of January 1, 2011. (Source: Natural Resources Conservation Service)

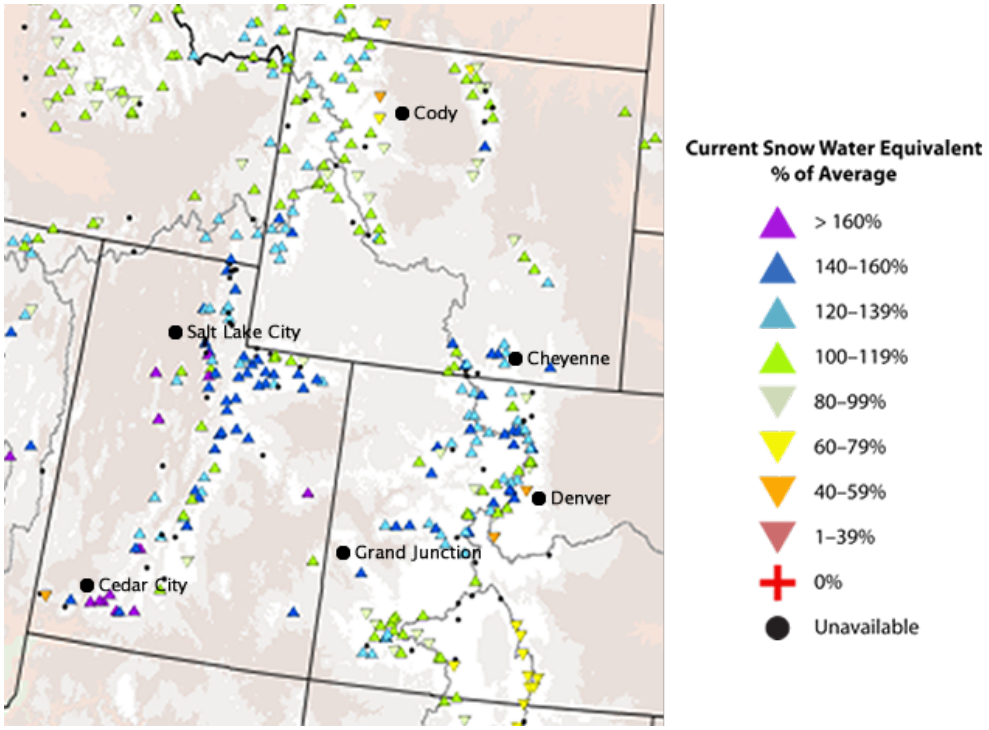

Figure SP-2. Current snow water equivalent (SWE) as a percent of average for individual SNOTEL sites as of January 12, 2011. (Source: Natural Resources Conservation Service)

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Spring and Summer Streamflow Forecasts for the 2011 Runoff Season

January is the first month in the water year in which the NRCS issues streamflow forecasts for the approaching spring and summer runoff. Although streamflow forecasts can change considerably from January to April, the January forecast does provide a preliminary indication of the likely runoff anomaly. Reflecting the generally above-average January 1 snowpacks, streamflow is forecasted to be above average in most basins across the Intermountain West, with the highest forecasted flows in southwestern **Utah** (Figure STRM-1) The Lake Powell inflow is forecast to be 120% of average, the highest January 1 forecast since 1997.

In **Colorado**, January 1 streamflow forecasts are the highest since 1997. Forecasts are for near-average to slightly above-average runoff in most of the state. Forecasts in the range of 120% to 140% of average have been made for the Grand Mesa, the Upper Yampa, the North Platte, and headwater tributaries of the Colorado. The Sangre de Cristo Mountains saw little benefit from the December storms, and the streams in this area reflect this with runoff forecasted at only 51 to 79% of average. October precipitation was above average in all drainages except the Upper Rio Grande, and this should lead to high soil moisture, and high runoff efficiency this spring.

Wyoming January 1 streamflow forecasts are near to above average for most basins in the state. On the higher end, the upper and lower North Platte are forecast at 140% and 147% of average, respectively. The only regions with significantly below-average forecasts are the Powder and Tongue River Basins at 76% and 74% of average, respectively. Other basins in the state have forecasts ranging from 99% to 124% of average, with a statewide average of 115%.

Utah streamflow forecasts are above to much above average throughout the entire state. Most forecasts are in the 130% to 160% range, with the highest in the Virgin, Beaver, and Sevier basins. The lowest flows are expected at the San Juan near Bluff, which is forecast at 106% of average. In addition to large snowpacks, Utah basins have very high measured soil moisture contents, which will increase runoff efficiency.

[Much of the text in this section comes from the NRCS State Basin Outlook Reports: http://www.wcc.nrcs.usda.gov/cgibin/bor.pl.]

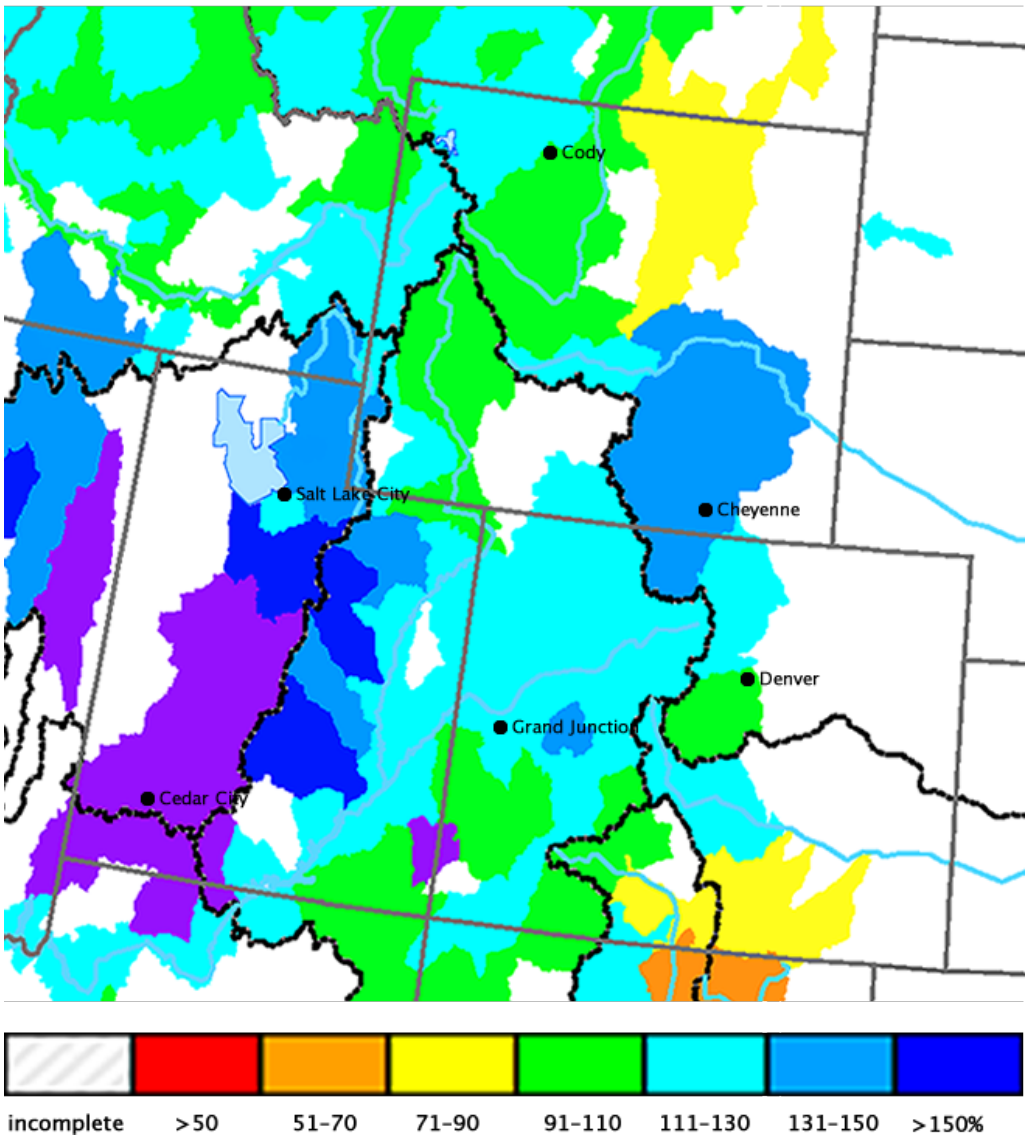

Figure STRM-1. NRCS outlook for natural streamflows for spring and summer in the Intermountain West region as a percent of average streamflows (data through January 1, 2011). (Source: Natural Resource Conservation Service)

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ENSO Status and Forecast

The current La Niña event has maintained borderline strong conditions into mid-winter, with negative sea surface temperature anomalies from 1° to 3°C persisting across a broad swath of the equatorial Pacific (Figure EN-1). The Multivariate ENSO Index (MEI) has increased slightly since early fall 2010, reflecting some weakening of La Niña conditions, but is still at its lowest level for this time of year since November/December 1988.

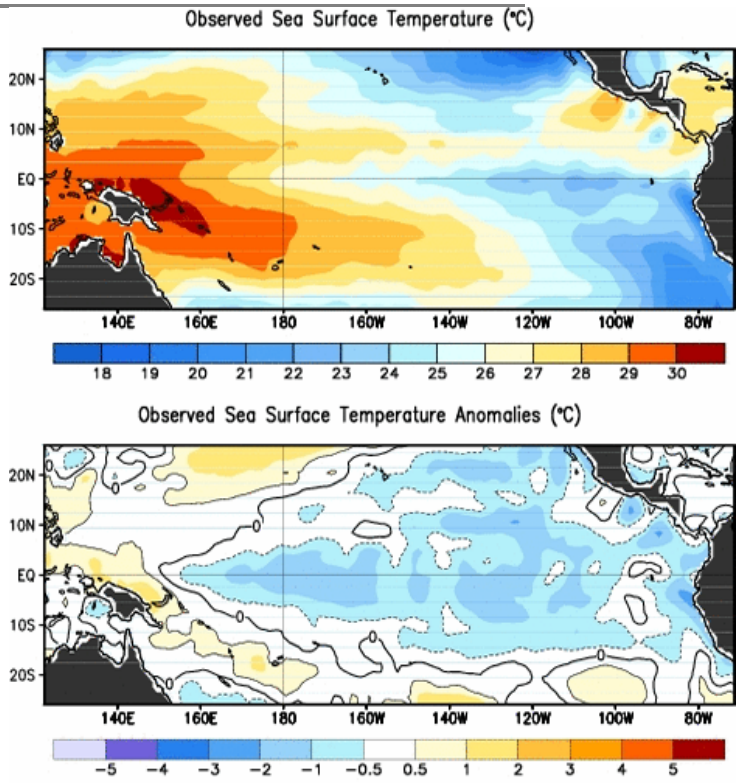

Figure EN-1. Observed SST (upper) and the observed SST anomalies (lower) in the Pacific Ocean. The Niño 3.4 region encompasses the area between 120°W–170°W and 5°N–5°S. The graphics represent the 7-day average centered on January 15, 2011. (Source: NOAA Climate Prediction Center)

Model forecasts of SST anomalies as compiled by the International Research Institute for Climate and Society (IRI) show a robust consensus that La Niña conditions will persist through Spring 2011 (March–May), albeit while progressively weakening and moving towards neutral conditions (Figure EN-2). There is little difference between the average trajectories of the dynamical models and of the statistical models at all time frames.

As was the case last October, a majority of the models project that a shift towards neutral conditions will occur by Summer 2011 (June–August), about 12 months after the emergence of the current La Niña. By Fall 2011 (September–November) only 4 of 16 models are forecasting that La Niña conditions will persist, with two models forecasting the emergence of El Niño conditions. Again, this model consensus is not entirely consistent with the observed history of strong La Niña events in the past century, which suggests that such La Niñas tend to persist for 1–3 years.

The NOAA ENSO Diagnostic Discussion will be updated on the first Thursday of February 2011.

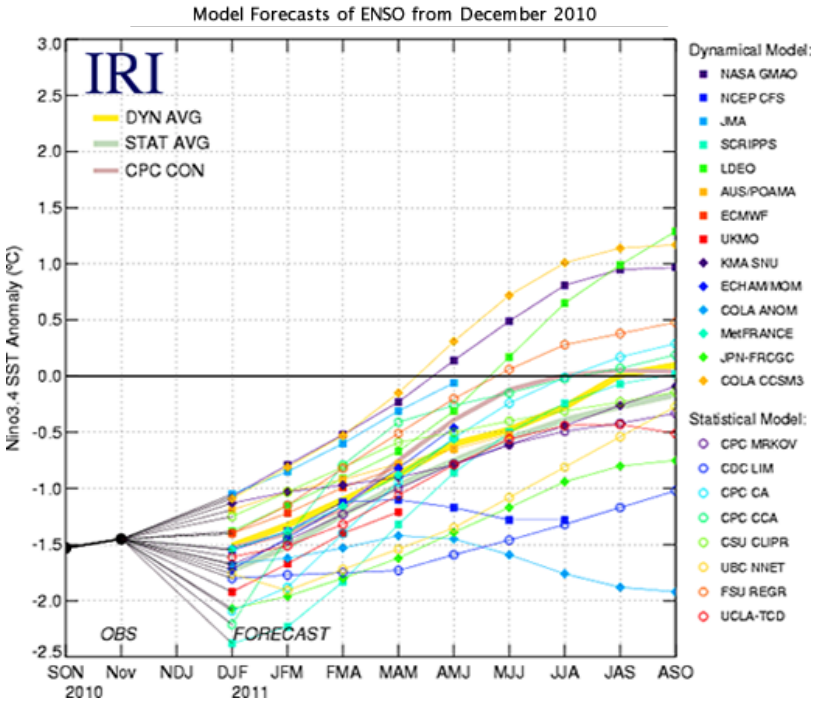

Figure EN-2. Forecasts made by dynamical and statistical models for sea surface temperatures (SST) in the Niño 3.4 region for nine overlapping 3-month periods from January–March 2011 to September–November 2011 (released January 20, 2011). (Source: International Research Institute (IRI) for Climate and Society)

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Temperature Outlook
February–June 2011 (Released January 20, 2011)

The latest temperature outlooks from the NOAA Climate Prediction Center indicate an enhanced risk of above-average temperatures across the southern portions of the Intermountain West in February 2010 and subsequent seasons (Figures TEMP-1 to TEMP-4). For February, the area with the most enhanced risk of warming covers the south-central region of the country, including southern **Colorado** and southeastern **Utah**. In subsequent seasons, this focal region for enhanced risk of warming shifts east and expands to the north covering most or all of Colorado and Utah.

Temperature impacts of La Niña over the U.S. are typically weak during the summer and early fall, and strengthen in subsequent seasons. With the persistence of strong La Niña conditions, the ENSO state has heavily influenced these outlooks for temperature for spring. There is also an overall trend towards warming conditions in the southwestern U.S. that is incorporated into the forecasts.

Note: these climate outlooks are intended for use prior to the start of their valid period (in this case, prior to the beginning of February). Within any given valid period observations and NWS short- and medium-range forecasts should be consulted. The February 2011 precipitation forecast will be updated on January 31st on the CPC web page. This "zero-lead" monthly update will incorporate information from the short range numerical weather prediction models and the latest monthly predictions from the Climate Forecast System models. The Seasonal Outlooks are updated on the third Thursday of the month, and the next one will be issued on February 17th.

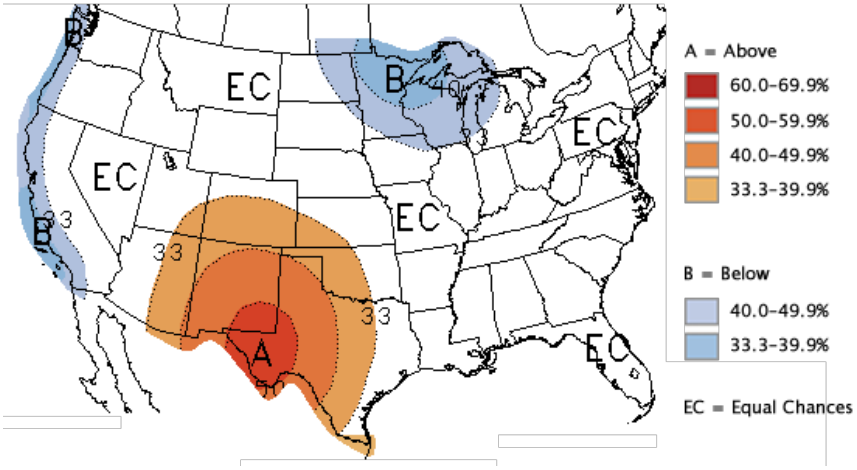

Figure TEMP-1. Long-lead national temperature forecast for February 2011. (Source: NOAA Climate Prediction Center)

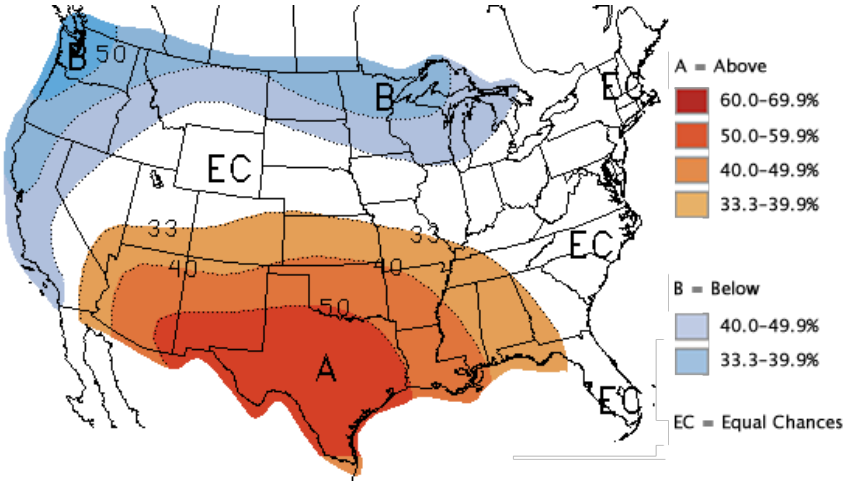

Figure TEMP-2. Long-lead national temperature forecast for February–April 2011. (Source: NOAA Climate Prediction Center)

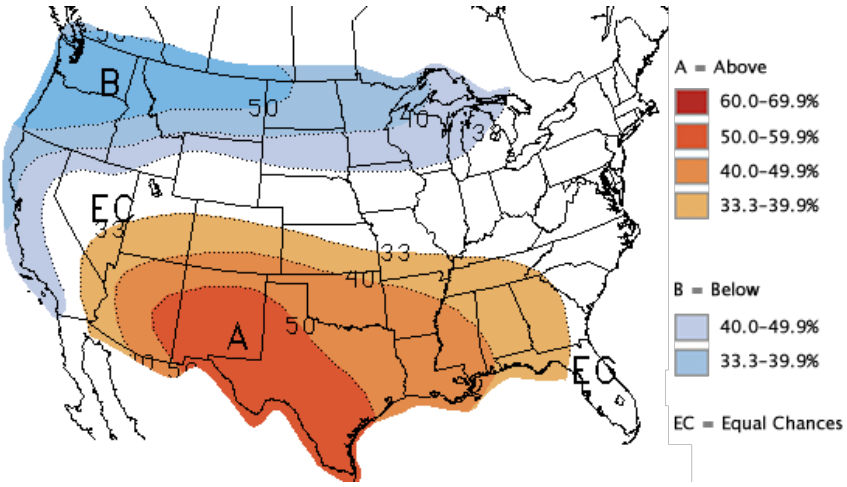

Figure TEMP-3. Long-lead national temperature forecast for March–May 2011. (Source: NOAA Climate Prediction Center)

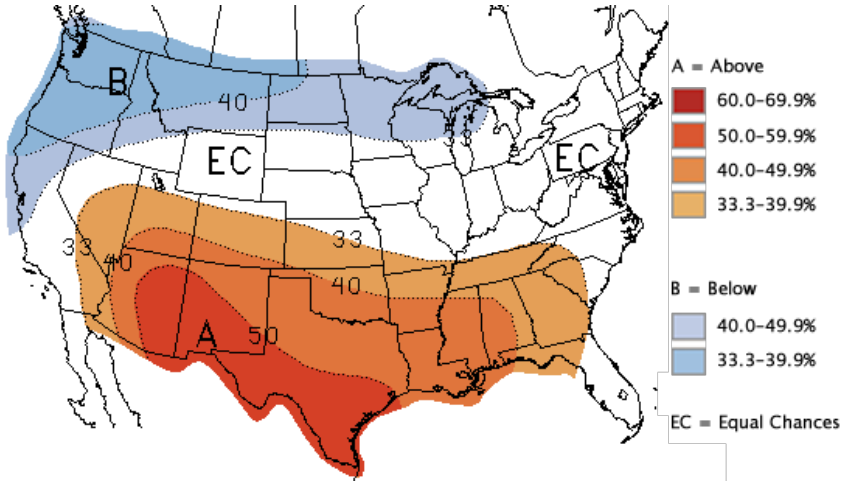

Figure TEMP-4. Long-lead national temperature forecast for April–June 2011. (Source: NOAA Climate Prediction Center)

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Precipitation Outlook
February–June 2011 (Released on January 20, 2011)

The CPC precipitation outlook for February 2010 (Figure PPT-1) shows an enhanced risk of below-average precipitation across the southwestern U.S., extending into far southern **Utah** and much of **Colorado**. For the February–April and March–May seasons, this region of enhanced drying risk expands slightly to the north, covering southern **Utah** and all of **Colorado**. In the April–June season, the risk of drier-than-average conditions shifts eastward and northward, covering all of Utah and **Colorado,** and southern **Wyoming,** with southern **Colorado** having greater drying risk (Figure PPT-4). Overall, the outlook for February–June is that drier-than-average conditions are likely across **Colorado** and **Utah**.

The areas of below-median precipitation described above are largely due to expected La Niña impacts on climate, including the typical La Niña-influenced tilt of the odds towards below-average precipitation for some areas of the southern tier.

Note: these climate outlooks are intended for use prior to the start of their valid period (in this case, prior to the beginning of February). Within any given valid period observations and NWS short- and medium-range forecasts should be consulted. The February 2011 precipitation forecast will be updated on January 31st on the CPC web page. This "zero-lead" monthly update will incorporate information from the short range numerical weather prediction models and the latest monthly predictions from the Climate Forecast System models. The Seasonal Outlooks are updated on the third Thursday of the month, and the next one will be issued on February 17th.

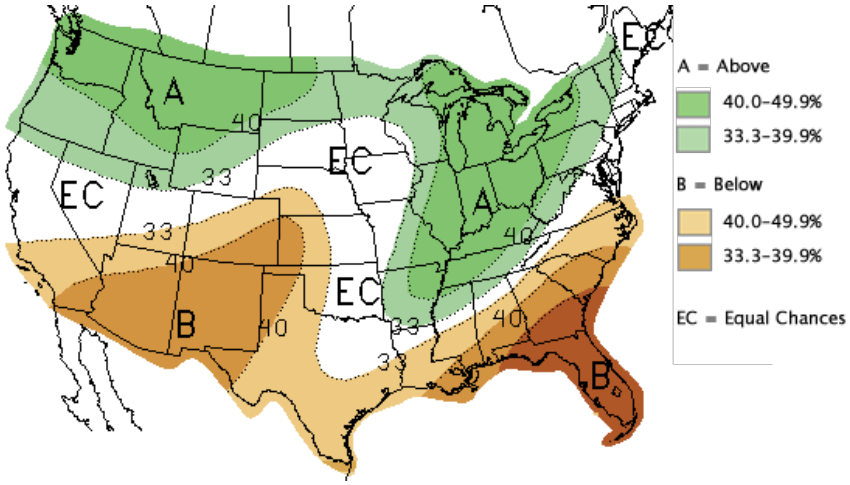

Figure PPT-1. Long-lead national precipitation forecast for February 2011. (Source: NOAA Climate Prediction Center)

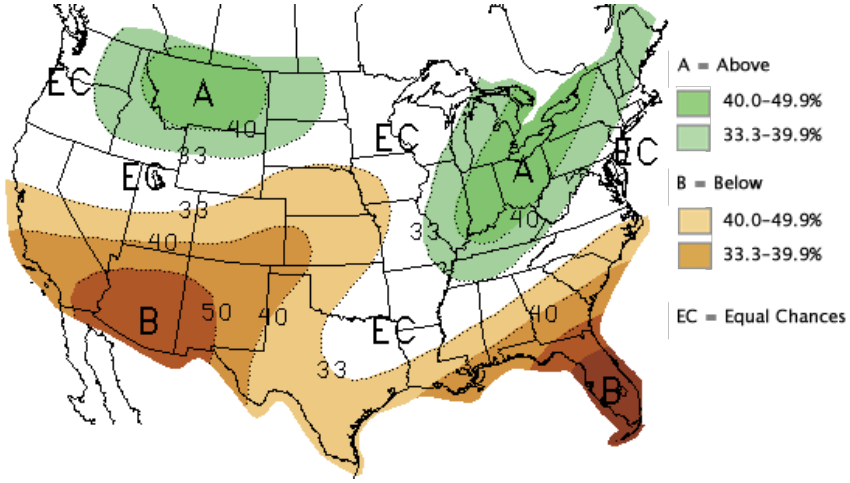

Figure PPT-2. Long-lead national precipitation forecast for February–April 2011. (Source: NOAA Climate Prediction Center)

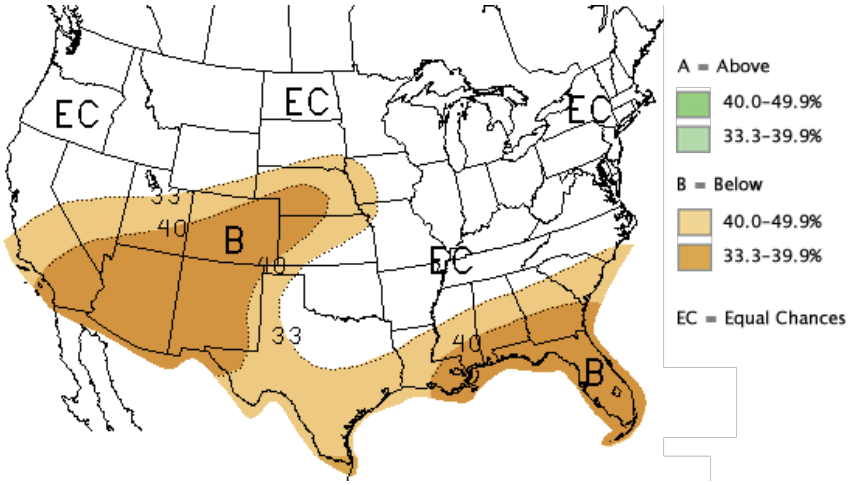

Figure PPT-3. Long-lead national precipitation forecast for March–May 2011. (Source: NOAA Climate Prediction Center)

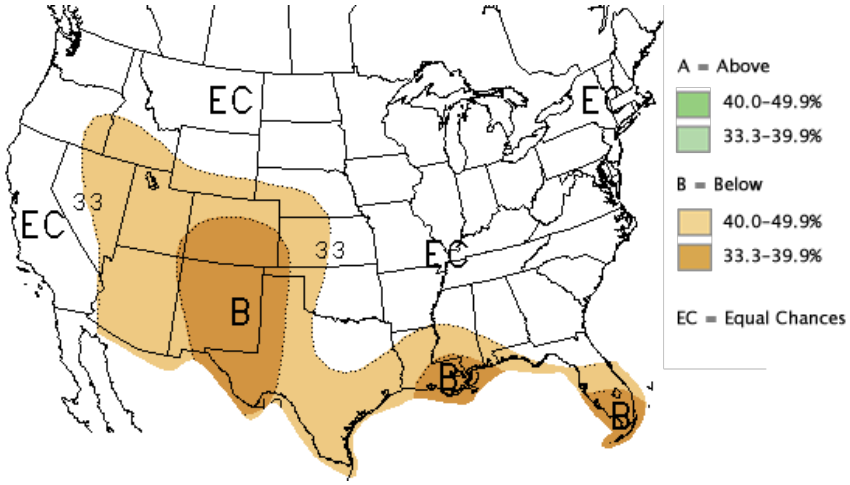

Figure PPT-4. Long-lead national precipitation forecast for April–June 2011. (Source: NOAA Climate Prediction Center)

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Seasonal Drought Outlook
through April 2011 (Released January 20, 2011)

The U.S. Seasonal Drought Outlook projects how drought areas categorized in the U.S. Drought Monitor might change and where new drought areas might develop. The areas in eastern **Colorado** currently categorized as moderate (D1) or severe drought (D2) are projected to continue to experience drought conditions over the next three months (Figure DO-1). A small portion of northeastern Colorado is projected to develop drought conditions, while the remainder of the three-state region is not expected to experience drought through April.

Readers interested in the next 1–5 days and 6–10 days can consult the "Looking Ahead" section of each week's Drought Monitor for near-term drought outlook conditions. The next Seasonal Drought Outlook will be issued February 3rd.

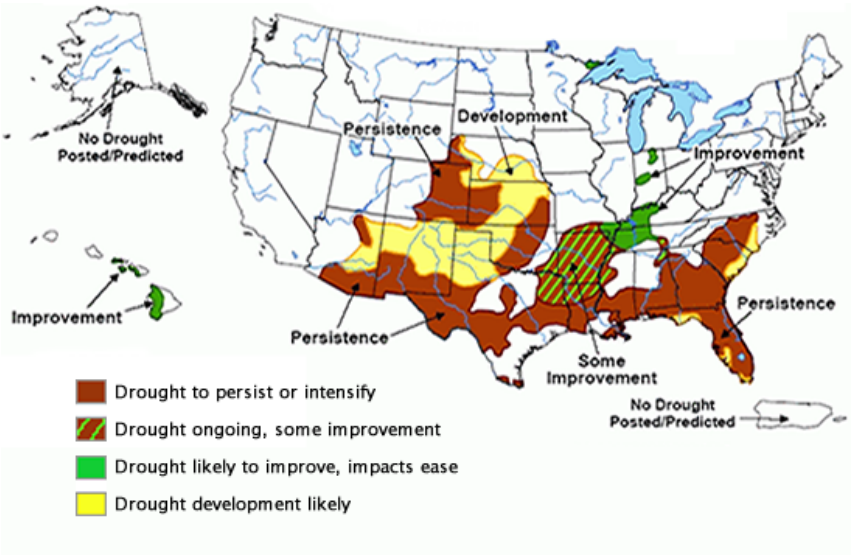

Figure DO-1. Seasonal Drought Outlook for January 20–April 2011. (Source: NOAA Climate Prediction Center)

Notes & Weblinks

(provides explanations of graphics and additional information sources)

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Cooperative Institute for Research in Environmental Sciences ■ University of Colorado Boulder ■ 216 UCB ■ Boulder, CO 80309-0216 ■ Phone: 303-735-8173