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INTERMOUNTAIN WEST CLIMATE SUMMARY

A product of the Western Water Assessment

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PRINTER-FRIENDLY VERSION

March 2010 Summary

Temperature & Precipitation — *February saw some extremely cold daily temperatures across the Intermountain region, and overall colder-than-average conditions for the month. An active Pacific jet brought above-average precipitation to central Colorado and southern Wyoming, with average or dry conditions elsewhere.*

Hydrological Conditions — *Above-average precipitation in October, December, and February in the mountains has led to average to above-average snowpacks across all of the region except southern Colorado. Accordingly, spring-summer streamflow forecasts as of March 1 are for average to above-average runoff in nearly all basins, with AprilÐJuly inflows to Lake Powell forecasted to be 116% of average.*

ENSO —*The current La Ni–a event continues to weaken, with a return to neutral ENSO conditions forecasted by most models by mid-summer. The La Ni–a is still expected to exert some influence on regional weather for the next several months.*

Climate Forecasts — *Consistent with the persistence of La Ni–a conditions, April is forecasted to have an enhanced risk of both above-average temperatures and below-average precipitation in Colorado and Utah. This tilt towards warmer conditions will weaken in the subsequent months, but the tilt toward drier conditions for Colorado and Utah is expected to persist through the summer.*

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Announcements & News

Colorado Climate Preparedness Project report and database released

WWA recently completed the Colorado Climate Preparedness Project (CCPP) for the state of Colorado. The CCPP is a catalog of climate impacts and climate adaptation activities and options for five climate-sensitive sectors throughout the state: water; wildlife, ecosystems, and forests; electricity; agriculture, and outdoor recreation.

For more information, see the Feature and Focus articles in this month's IWCS (links below), download the CCPP report (PDF, 5MB), and access the CCPP database.

Pine Beetle-Water Symposium - April 25, Boulder, CO

Please join us on April 25, 2011 for WWA's 2nd annual science symposium exploring the water-related impacts of mountain pine beetle infestations in the Rocky Mountain West. The Mountain Pine Beetle Science Symposium:

Impacts on the Hydrologic Cycle and Water Quality: What Have we Learned? will feature presentations from research groups around the Interior West.

For more information, download the flier (PDF, 1.1 MB), visit the symposium webpage, or email us at wwa@noaa.gov.

Streamflow Forecast Workshop: Using & Improving the Tools Available - June 21, Salt Lake City, UT

Participants at this workshop will have the opportunity to hear about the latest science relevant to the Colorado River and Great Basin rivers, and will receive training in a computer lab setting on using the new Colorado Basin River Forecast Center (RFC) online resource. Participants will also be able to provide opinions and insight directly to the developers so the RFC can improve the tool.

For more information, visit the workshop web page, or email us at wwa@noaa.gov.

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Feature Article

The Colorado Climate Preparedness Project Ð Capturing the state of climate adaptation in Colorado

by Jeff Lukas, WWA; Roberta Klein, CIRES Center for Science and Technology Policy Research (CSTPR), University of Colorado Boulder; Eric Gordon, WWA; and William Travis, Department of Geography and CIRES Center for Science and Technology Policy Research (CSTPR), University of Colorado Boulder

(download pdf)

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Focus Article

The Colorado Climate Preparedness Project (CCPP) Database: A catalog of resources and capacity for climate adaptation

by Kelsey Cody, University of Colorado Boulder; and Jeff Lukas, Western Water Assessment

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Recent Climate Conditions

In February, cold gripped much of the Intermountain West region, including Colorado, Wyoming, and the Uinta basin in Utah (Figures RC-1 and RC-2). A particularly severe Arctic air outbreak the first week of February saw minimum temperatures below -40iF in some mountain valley locations, and below -15iF in the Denver area. For the month, across much of **Wyoming,** portions of northern and south-central **Colorado**, and northeastern **Utah**, temperatures were 6Ð10iF below normal. Most of the remainder of the three-state region saw temperatures 2Ð 6iF below normal.

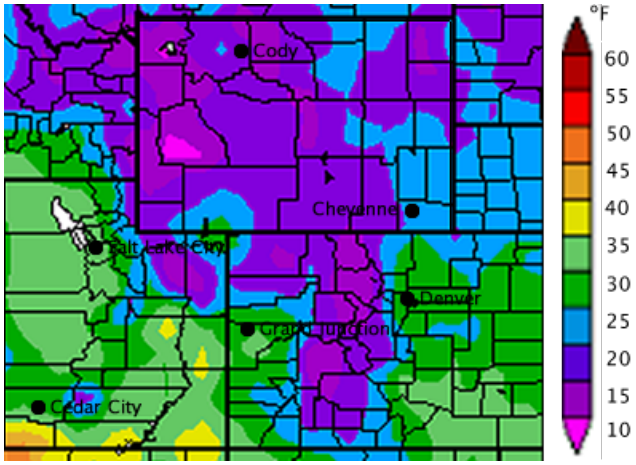


Figure RC-1. Average temperature for the month of February 2011 in iF. (Source: High Plains Regional Climate

Center)

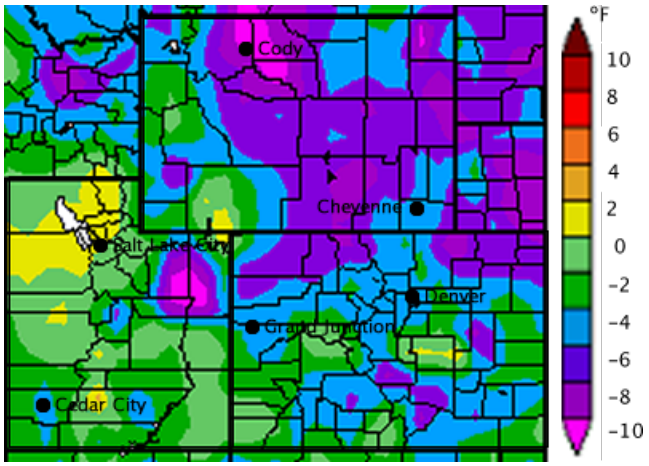


Figure RC-2. Departure from average temperature for the month of February 2011 in iF. (Source: High Plains Regional Climate Center)

In February, a strong Pacific jet which consistently tracked over the middle of the region brought abundant snow to the mountain ranges in southern **Wyoming** and central and northwestern **Colorado**, which received up to 200% of average precipitation for the month (Figures RC-3 and RC-4). Eastern and southwestern **Colorado**, along with much of southern **Utah** and northern **Wyoming**, were not favored by this pattern, receiving less than 60% of average precipitation for the month.

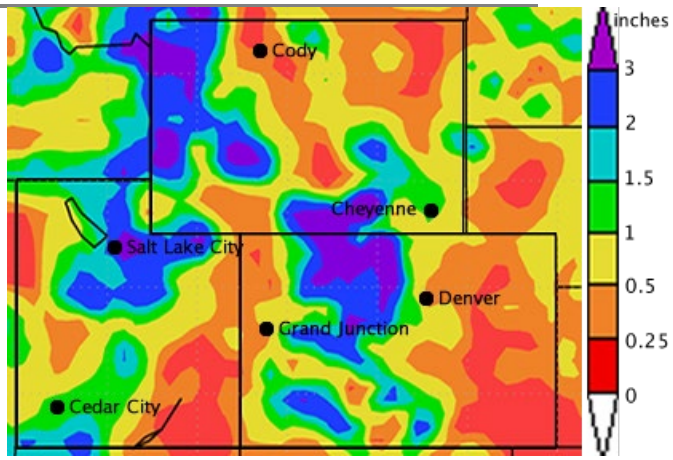


Figure RC-3. Precipitation for the month of February 2011 (inches). (Source: NOAA ESRL Physical Science Division)

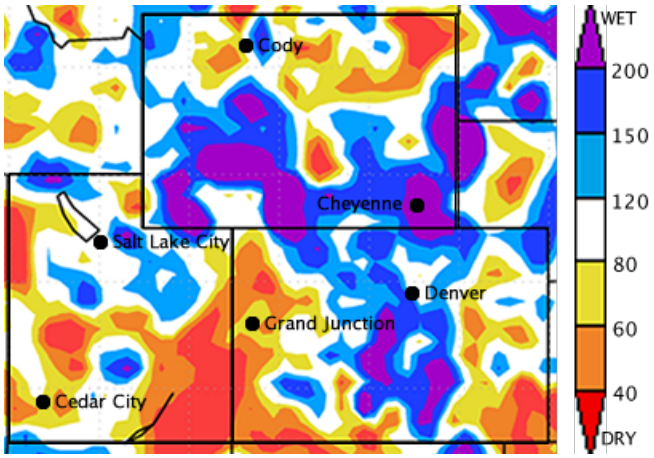


Figure RC-4. Precipitation for the month of February 2011 as percent of average precipitation for February. (Source: NOAA ESRL Physical Science Division)

The 3-month SPI (Figure RC-5) indicates moderately wet conditions across much of western and northern **Utah** and portions of southern and eastern **Wyoming**. Very wet conditions are shown across central **Utah**, while all of Colorado remains near normal. The 36-month SPI (Figure RC-6), shows near-normal conditions across almost all of the three-state region. Eastern **Wyoming** and northeastern **Colorado** show wet conditions over this three-year period, while northwestern **Wyoming** and south-central **Colorado** were moderately to very dry.

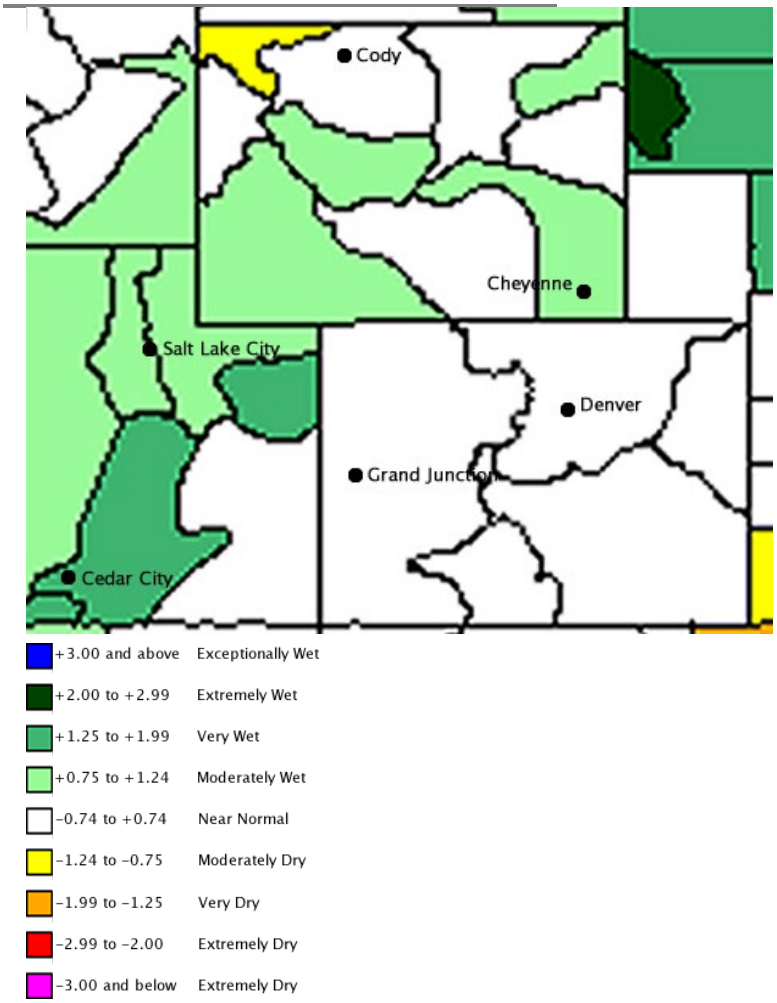
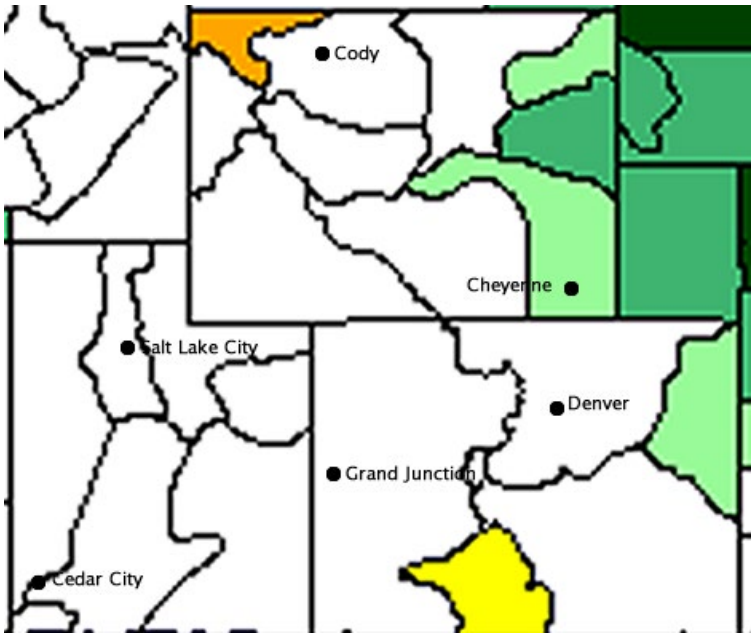


Figure RC-5. 3-month Intermountain West regional Standardized Precipitation Index as of the end of February 2011 (data from 12/01/10Ð2/28/11). (Source: Western Regional Climate Center)



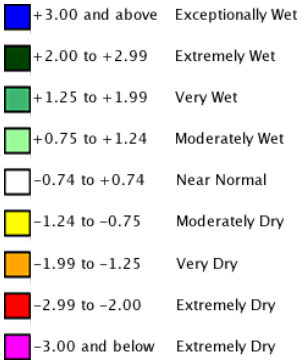


Figure RC-6. 36-month Intermountain West regional Standardized Precipitation Index as of the end of February 2011 (data from 3/01/08Ð2/28/11). (Source: Western Regional Climate Center)

The U.S. Drought Monitor issued March 15 indicates worsening drought conditions across nearly all of eastern **Colorado**, which is now classified as D2, or severe drought. Western **Wyoming** remains abnormally dry, while the remainder of the three-state region is not experiencing drought conditions (Figure RC-7).

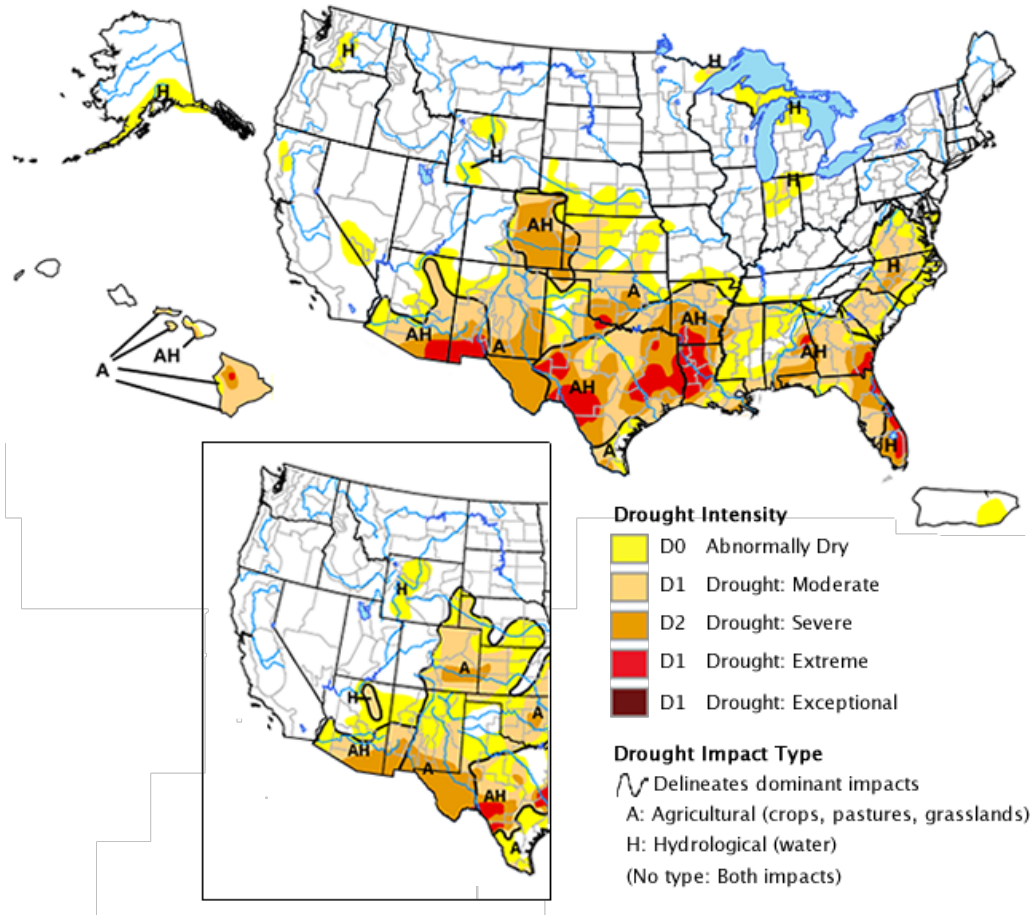


Figure RC-7. U.S. Drought Monitor from March 15, 2011 (full size) and February 1, 2011 (inset, lower left) for comparison. (Source: National Drought Mitigation Center)

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Intermountain West Snowpack

March 1 snowpacks (as measured by snow-water equivalent) in the three-state region were near or above the long-term average in almost all basins in the region, with the only exceptions being in southern Colorado (Figure

SP-1).

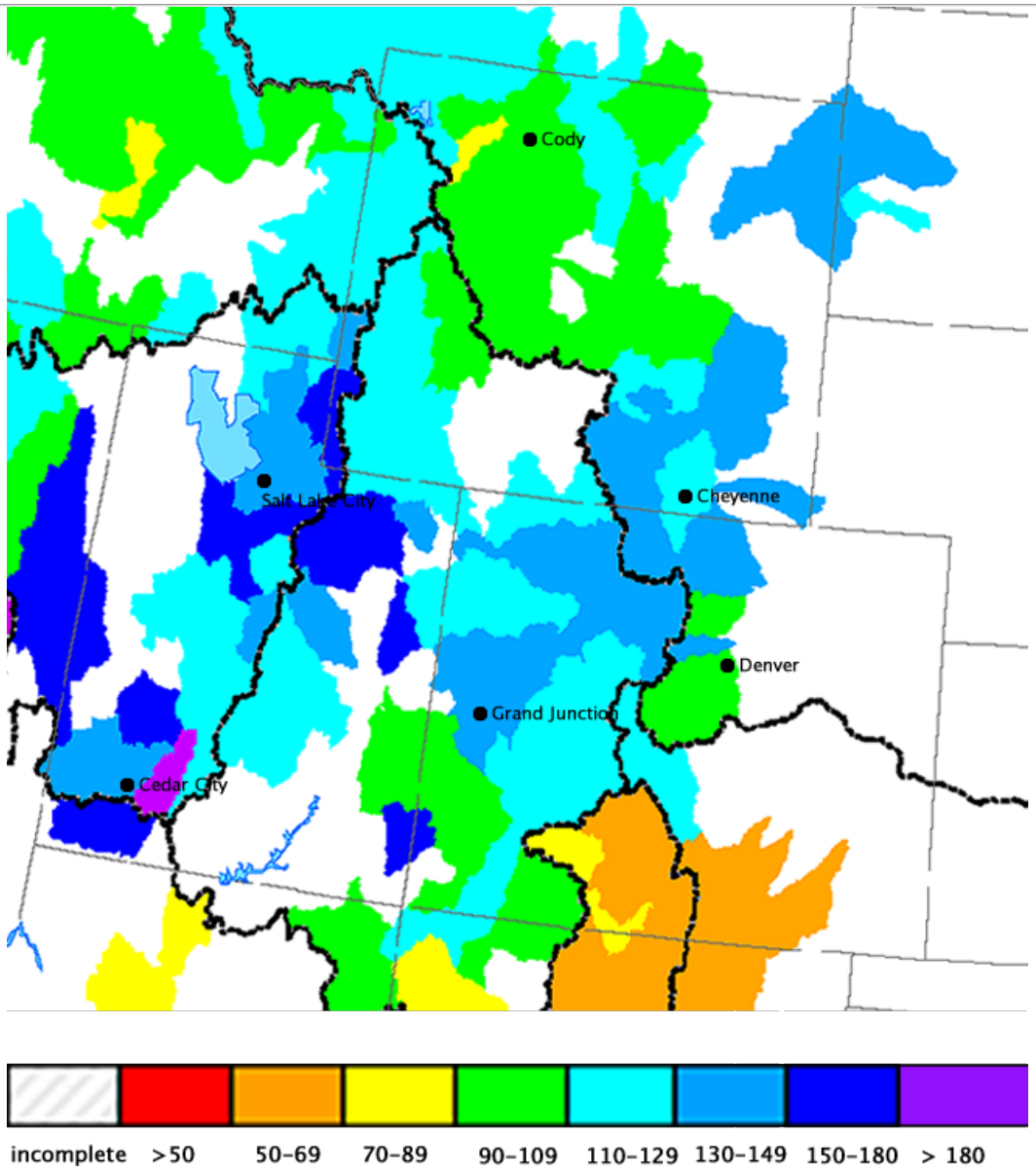

Figure SP-1. Snow water equivalent (SWE) as a percent of average for available SNOTEL and snow course sites, averaged across each basin, in the Intermountain West as of March 1, 2011. (Source: Natural Resources Conservation Service)

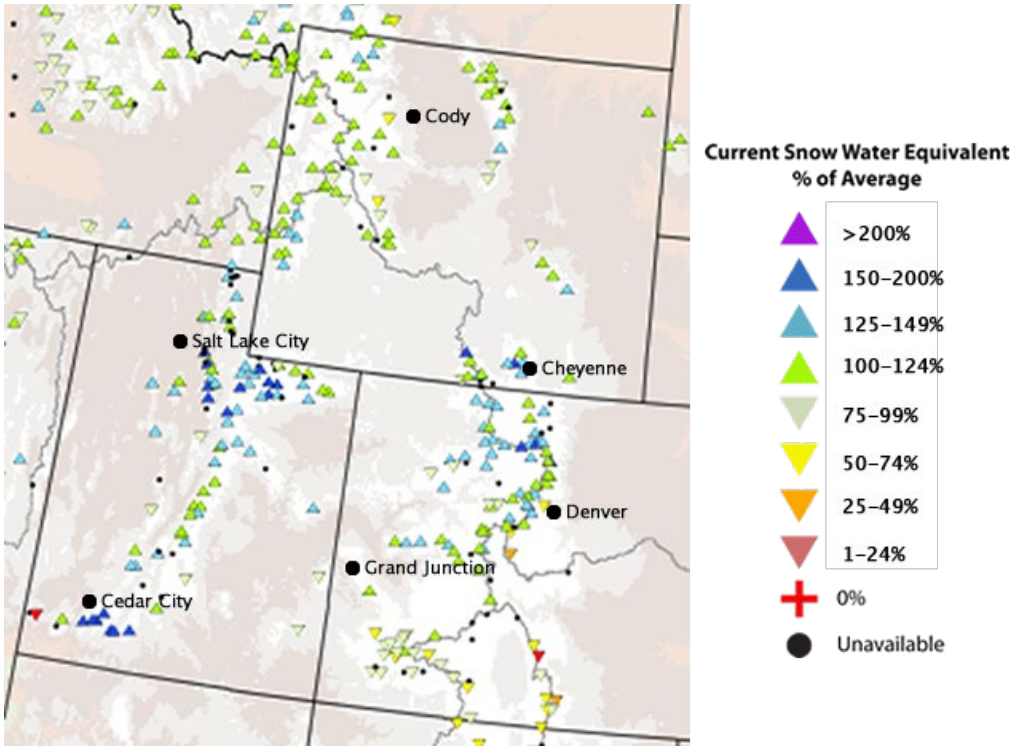

Figure SP-2. Current snow water equivalent (SWE) as a percent of average for individual SNOTEL sites as of March 21, 2011. (Source: Natural Resources Conservation Service)

In **Colorado**, March 1 snowpacks were near average to above average in all but the Upper Rio Grande Basin, which were 90% of average. The Laramie and North Platte basins recorded the highest snowpacks in the state, at 130% of average and overall, basins statewide were 115% of average. January precipitation was far below average for the southern half of the state, but February precipitation was above average for all but the southwestern basins. As of March 1, water year precipitation ranged from 92% of average on the Upper Rio Grande to 138% on the Laramie and North Platte.

Statewide snowpack across **Utah** was 133% of average, the highest March 1 measurements since 1997. All basins recorded above-average March 1 snowpacks, ranging from 121% in southeastern Utah to 159% for southwestern Utah. January precipitation was below average statewide, and extremely dry in southern Utah. Although January precipitation was below average statewide and extremely dry in the southern part of the state, February precipitation was near to above-average statewide. March 1 water-yearÐto-date precipitation was above average in all basins, and 147% of average statewide.

Wyoming snowpacks were above average in all basins as of March 1, with a statewide average of 116%. Individual basins ranged from 103% for the Shoshone to 134% for the Upper North Platte and Upper Bear. January precipitation was higher in Wyoming than Colorado or Utah, with mostly above-average measurements. February precipitation was yet higher, bringing March 1 water-year-to-date precipitation over 100% of average in nearly all basins.

Snowpack update, March 21st: Snowpack conditions have been relatively stable since the first of the month (Figure SP-2). Most basins in Wyoming have increased slightly or remained the same. Most basins in Utah and Colorado have had small decreases in percent-of-average SWE, and the Virgin basin has seen the start of spring melt-out. Southeastern Utah, the Sevier Basin, and the Upper Rio Grande Basin have also shown some melt.

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

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Spring and Summer Streamflow Forecasts for the 2011 Runoff Season

The spring and summer streamflow forecasts issued on March 1 call for near-average to above-average AprilÐJuly runoff for most of the region, including nearly all of **Wyoming,** most of **Colorado,** and eastern **Utah**. Western

Utah forecasts are for above-average to much-above-average runoff, while forecasted runoff is below average for far southern **Colorado** (Figure STRM-1). The inflow to Lake Powell is forecasted to be 116% of average. Since the initial WY 2011 streamflow forecasts were released in January, the streamflow outlook has improved somewhat in **Wyoming**, and worsened for southern **Colorado**.

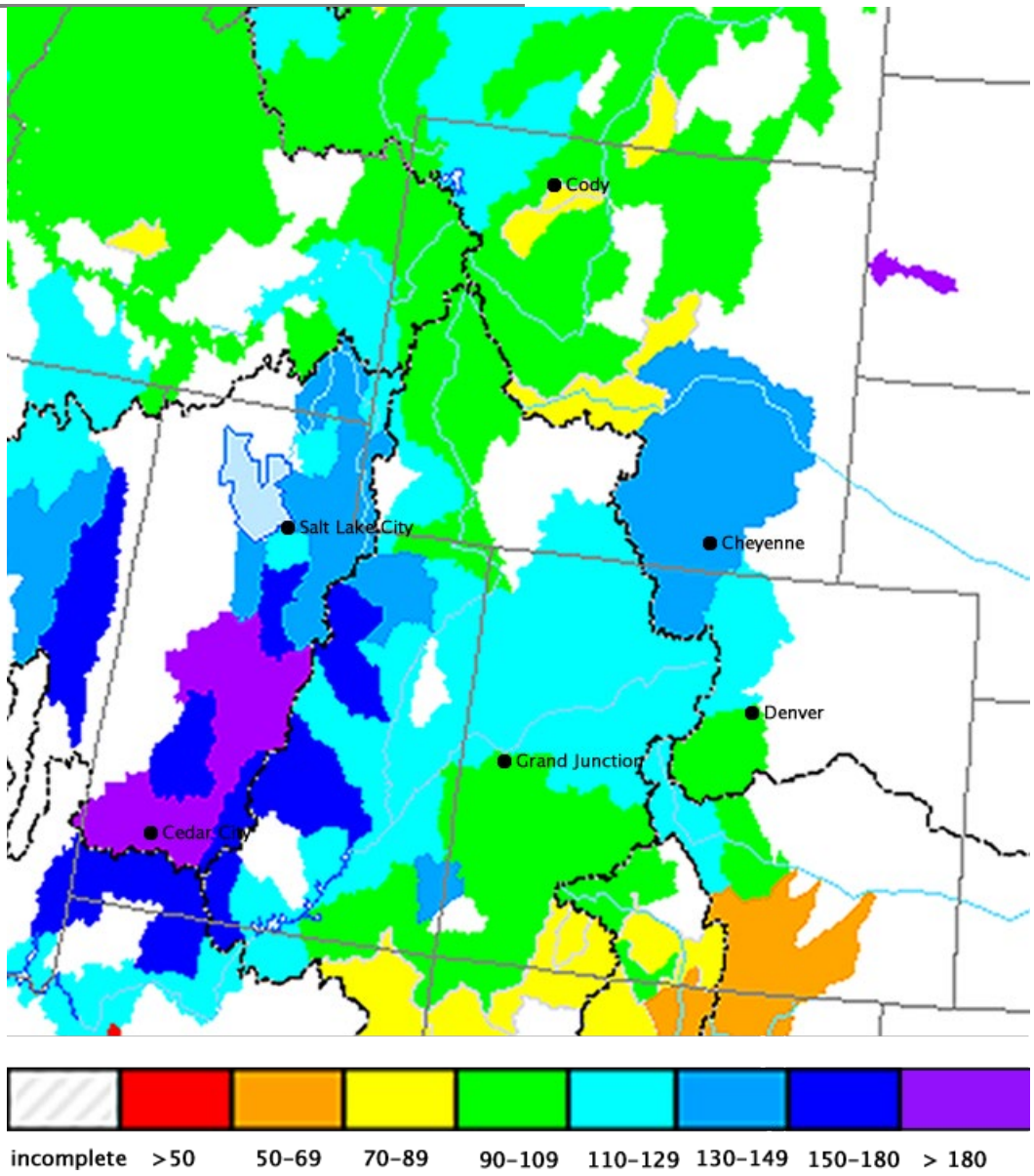

Figure STRM-1. NRCS outlook for natural streamflows for spring and summer in the Intermountain West region as a percent of average streamflows (data through March 1, 2011). (Source: Natural Resource Conservation Service)

In **Colorado**, March 1 streamflow forecasts follow the same north-south trend as the snowpack conditions. In the northwest part of the state, forecasts range from around 120% to almost 150% of average in the Yampa, Colorado, and North Platte basins. In the central part of the state, including the Gunnison, South Platte and Arkansas headwaters, the forecasts range from 90Ð120% of average. The lowest runoff forecasts in the state are for streams draining the southern Sangre de Cristo Mountains, which range from 40Ð70% of average. Below-average runoff is also forecasted for the other basins in southern Colorado.

Wyoming March 1 streamflow forecasts are for near-average to much-above-average runoff for the major basins in the state. On the higher end, the Belle Fourche and Cheyenne Rivers are forecasted to be 206% and 222% of average, respectively. Statewide, forecasted runoff is 111% of average. Slightly below average runoff is forecasted for the Tongue, Wind and Bighorn River basins, at 88%, 93% and 97% of average, respectively.

Utah March 1 streamflow forecasts are for above-average to much-above-average runoff throughout the state, with only a few exceptions. Most forecasts are in the 120Ð160% of average range, with the highest in the Virgin, Beaver, and Sevier basins. The only below-average runoff is expected at the San Juan near Bluff, and South Creek

near Monticello, forecasted at 85% and 89% of average respectively. In addition to large snowpacks, Utah basins have very high measured soil moisture contents, which will increase runoff efficiency.

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Reservoir Supply

March is typically the last full month for snowpacks to receive a boost in accumulation before warmer temperatures commence the spring runoff, and reservoirs begin to fill. As of the end of February, reservoir levels were generally near average or above average in **Wyoming** and **Colorado**, with a more mixed picture in **Utah** (Figure RES-1).

Colorado's reservoir storage was slightly above the long-term average. Statewide storage was 104% of average on March 1 and is 100% of last year's contents on this same date. Even with the near to above average storage across most of the state, all basins remain well below the available storage capacity, with plenty of room for this spring's runoff. Statewide storage is at 58% of capacity with the ability to store more than 2.5 million acre-feet of runoff.

Storage in 41 of **Utah**Õs key irrigation reservoirs was at 70% of capacity, 2% more than last year. Lake Powell was 53% full, compared with 57% full at the end of February 2010. As in Colorado, there is sufficient reservoir capacity to capture much of the forecasted above-average spring-summer runoff.

Reservoir storage varies widely across **Wyoming**, with statewide contents at 109% of average. The state's largest reservoir, Flaming Gorge, was at 84% full and 108% of average for the end of February.

	RESERVOIR	current storage (af)	capacity (af)	% full	% of average for 2/28
COLORADO	Dillon Reservoir	225,115	257,304	87%	103%
	Turquoise Lake	47,361	129,390	37%	59%
	Lake Granby	402,774	539,758	75%	135%
	Blue Mesa	511,916	829,500	62%	115%
	Pueblo	251,094	330,664	76%	127%
UTAH	Strawberry	977,000	1,106,500	88%	153%
	Utah Lake	885,000	870,900	102%	107%
	Bear Lake	426,700	1,302,000	33%	58%
	Lake Powell	12,966,264	24,322,000	53%	64%
WYOMING	Fontenelle	142,629	344,800	41%	91%
	Flaming Gorge	3,142,139	3,749,000	84%	108%
	Seminoe	741,550	1,017,273	73%	164%
	Boysen	598,999	741,594	81%	105%
	Buffalo Bill	435,286	644,126	68%	108%

Figure RES-1. End-of-month contents of selected large reservoirs in the Intermountain West Region."Current Storage" reflects contents as of February 28, 2011. Reservoir data are shaded according to the "% of Average" value as follows: green: >90% of average; light green: 60Ð89%; yellow: 40Ð59%; orange: 20Ð39%; red: 0Ð 19%

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ENSO Status and Forecast

Since January 2011, negative (cold) anomalies in sea surface temperature have weakened in the central and eastern Pacific, and anomalies have become positive (warm) in portions of the far eastern Pacific, indicating the

continued weakening of the current La Ni–a (Figure EN-1).

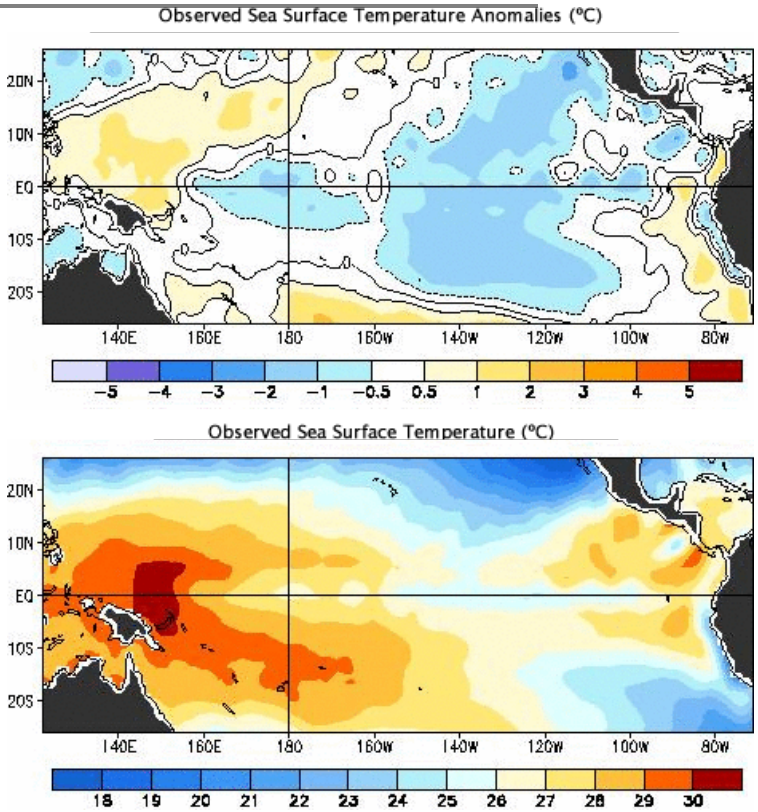

Figure EN-1. Observed SST (lower) and the observed SST anomalies (upper) in the Pacific Ocean. The Ni–o 3.4 region encompasses the area between 120iWÐ170iW and 5iNÐ5iS. The graphics represent the 7-day average centered on March 16, 2011. (Source: NOAA Climate Prediction Center)

Across a broad set of dynamical and statistical ENSO forecast models, nearly all models indicate that La Ni–a will weaken further in the coming months. A majority of models indicate ENSO-neutral conditions by MayÐJuly 2011 (Figure EN-2), though the forecast discussion for the experimental PSD precipitation forecast guidance (see below) suggests that, based on past La Ni–a behavior, there is a good chance of La Ni–a conditions re-establishing in the fall.

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

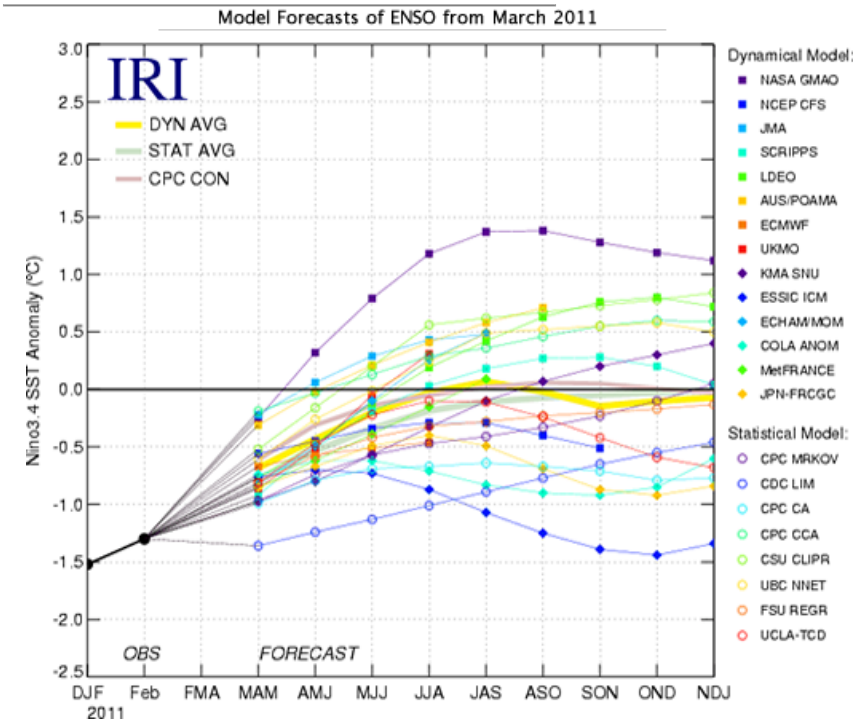

Figure EN-2. Forecasts made by dynamical and statistical models for sea surface temperatures (SST) in the Ni–o 3.4 region for nine overlapping 3-month periods from MarchÐMay 2011 to November 2011ÐJanuary 2012 (released March 16, 2011). (Source: International Research Institute (IRI) for Climate and Society)

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Temperature Outlook
April–August 2011 (Released March 17, 2011)

The latest temperature outlooks from the NOAA Climate Prediction Center indicate an enhanced risk of warmer-than-average temperatures in Utah, Colorado, and portions of Wyoming in April and the AprilÐJune through JuneÐ August seasons (Figures TEMP-1 through TEMP-4). These outlooks for our region are consistent with the typical spring influence of La Ni–a conditions.

Note: These climate outlooks are intended for use prior to the start of their valid period (in this case, prior to the beginning of April). Within any given valid period, observations and NWS short- and medium-range forecasts should be consulted. The April 2011 temperature forecast will be updated on March 31st on the CPC web page. This Òzero-leadÓ 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 April 21st.

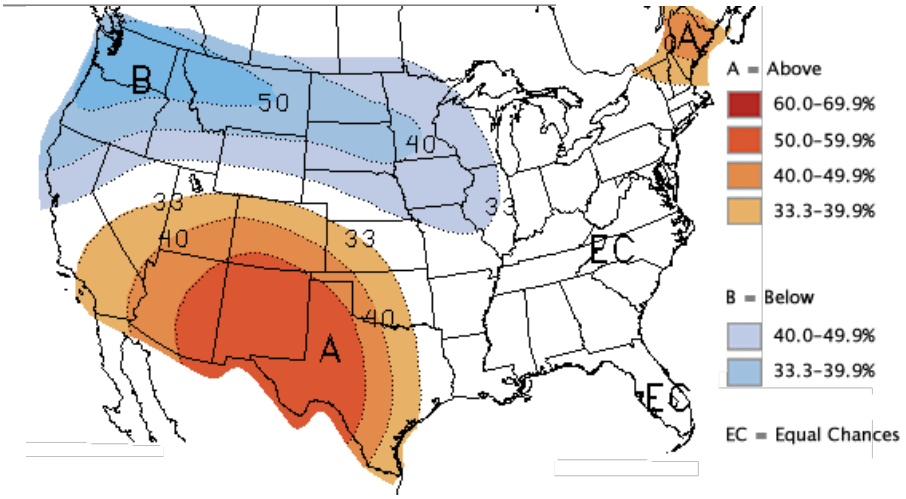

Figure TEMP-1. Long-lead national temperature forecast for April 2011. (Source: NOAA Climate Prediction Center)

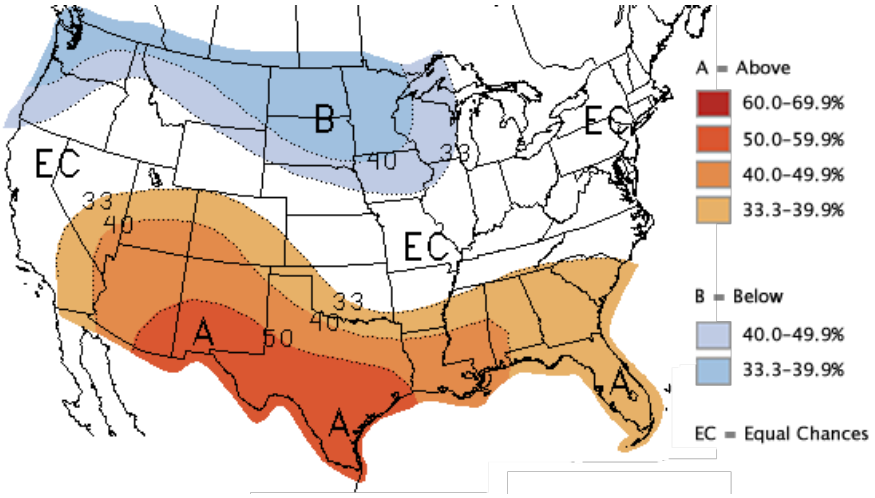

Figure TEMP-2. Long-lead national temperature forecast for AprilÐJune 2011. (Source: NOAA Climate Prediction Center)

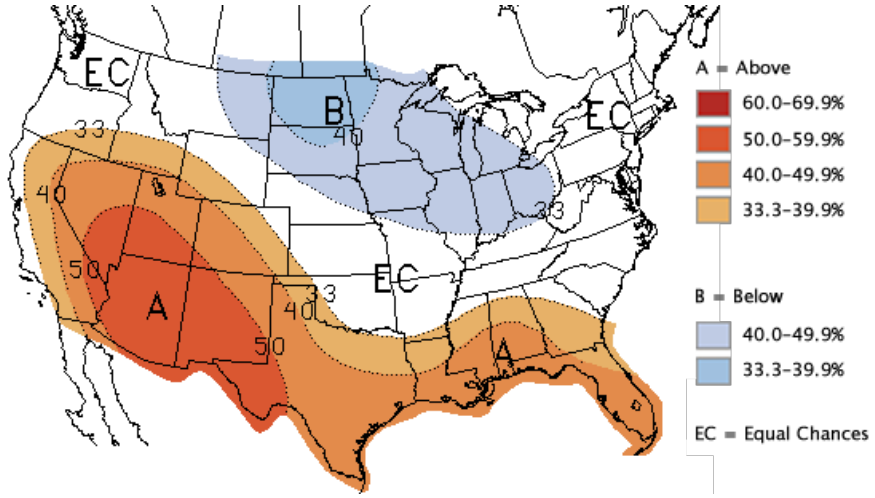

Figure TEMP-3. Long-lead national temperature forecast for MayÐJuly 2011. (Source: NOAA Climate Prediction Center)

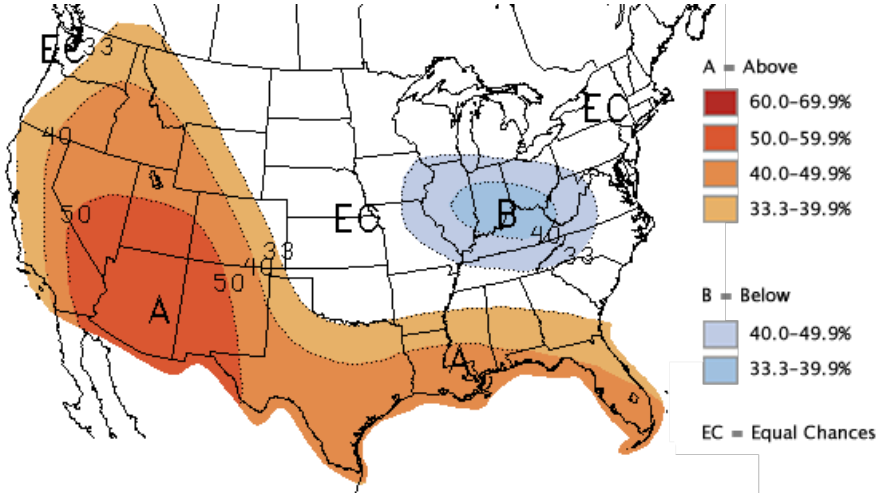

Figure TEMP-4. Long-lead national temperature forecast for JuneÐAugust 2011. (Source: NOAA Climate Prediction Center)

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Precipitation Outlook
April–August 2011 (Released on March 17, 2011)

The CPC precipitation outlook for April 2011 (Figure PPT-1) shows an enhanced risk of below-average precipitation for Utah and **Colorado**. For the AprilÐJune season, the area of enhanced risk of drier-than-average conditions shifts to the south, covering only parts of southern **Colorado** and **Utah** (Figure PPT-2). For the summer seasons, the Intermountain region has equal chances ("EC") of wetter or drier than average conditions (Figures PPT-3 and PPT-4).

Areas of above- or below-average precipitation are largely due to expected La Ni–a impacts on climate, including the typical La Ni–a-influenced tilt of the odds towards below-average precipitation for some areas of the southern tier, and towards wet conditions for the Pacific Northwest and Ohio Valley.

Note: these climate outlooks are intended for use prior to the start of their valid period (in this case, prior to the beginning of April). Within any given valid period, observations and NWS short- and medium-range forecasts should be consulted. The April 2011 precipitation forecast will be updated on March 31st on the CPC web page. This Òzero-leadÓ 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 April 21st.

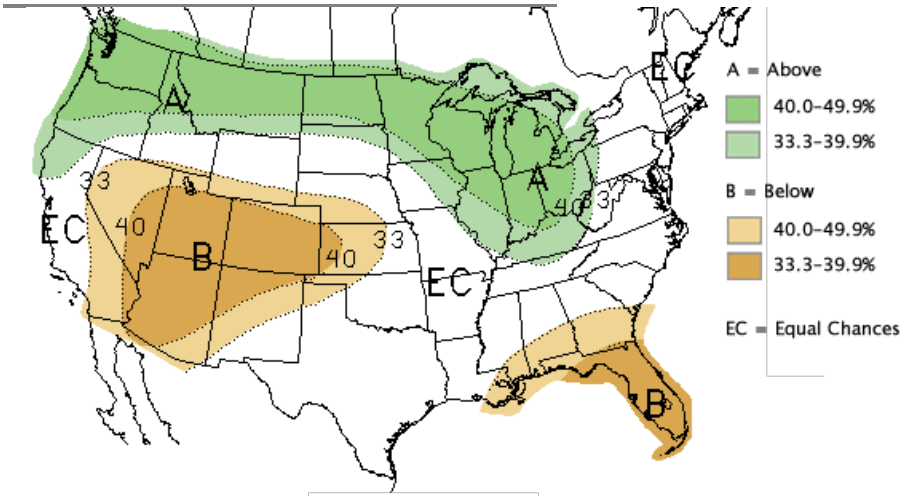

Figure PPT-1. Long-lead national precipitation forecast for April 2011. (Source: NOAA Climate Prediction Center)

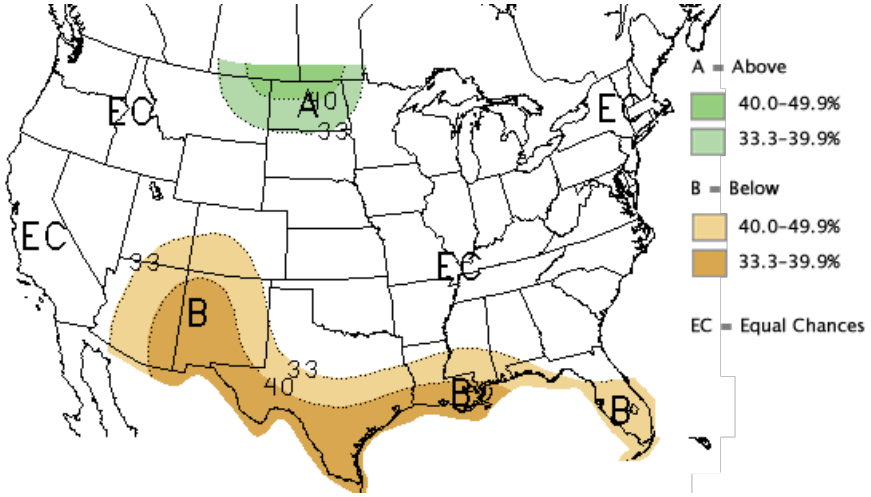

Figure PPT-2. Long-lead national precipitation forecast for AprilÐJune 2011. (Source: NOAA Climate Prediction Center)

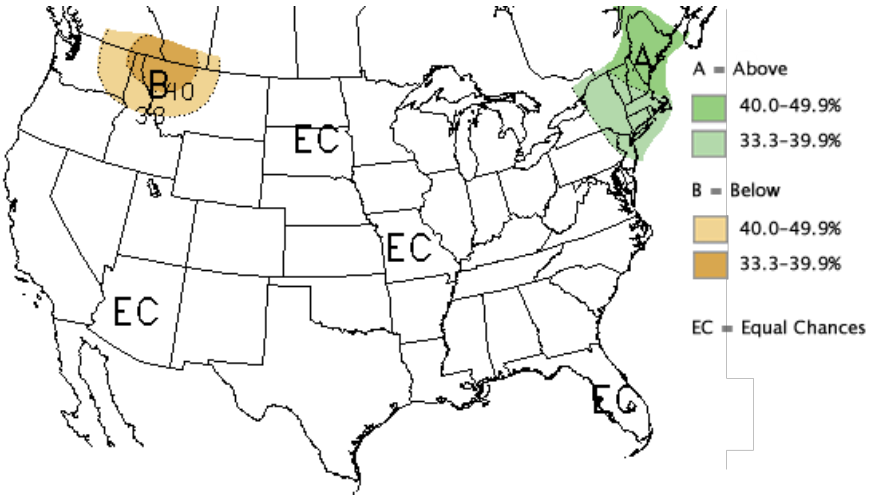

Figure PPT-3. Long-lead national precipitation forecast for MayÐJuly 2011. (Source: NOAA Climate Prediction Center)

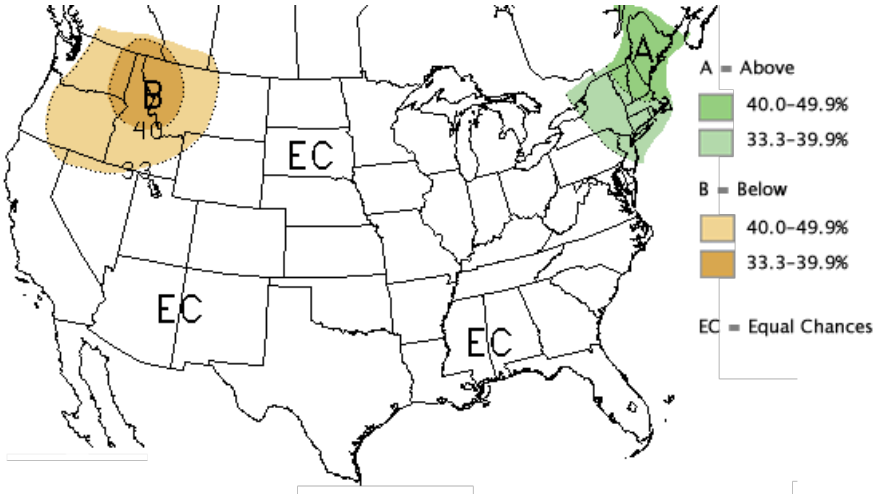

Figure PPT-4. Long-lead national precipitation forecast for JuneÐAugust 2011. (Source: NOAA Climate Prediction Center)

According to the experimental PSD Precipitation Forecast Guidance, there is a tilt towards dryness for the AprilÐ June period covering the southern and eastern parts of Colorado and southern Utah, while near-average or even wetter-than-average conditions might continue over northwestern Colorado (Figure PPT-5). The best opportunity for relief from this expected dry spring in Colorado may come in April along the Front Range.

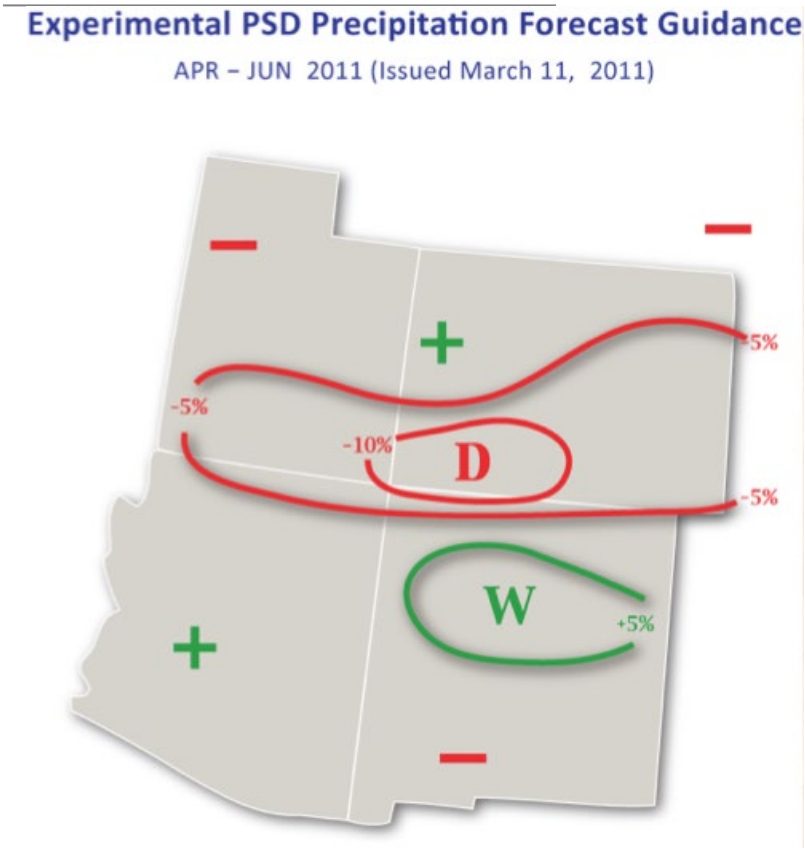

Figure PPT-5. Experimental precipitation forecast guidance. Forecasted shifts in tercile probabilities for AprilÐJune 2011. (Source: NOAA ESRL Physical Science Division)

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Seasonal Drought Outlook
through June 2011 (Released March 17, 2011)

The U.S. Seasonal Drought Outlook (DO) builds on the Drought Monitor categories to project how these drought areas might change or where new drought areas might develop. Eastern **Colorado**, which is currently experiencing severe drought (D2) conditions, is projected to see those conditions persist or worsen over the next three months (Figure DO-1). Drought is expected to develop in portions of southern **Colorado** and southeastern **Utah**, while the remainder of the region is unlikely to see development of drought conditions.

Readers interested in the next 5 and 6Ð10 days can consult the ÒLooking AheadÓ section of each weekÕs Drought Monitor for near-term drought outlook conditions. The next Seasonal Drought Outlook will be issued April 7th.

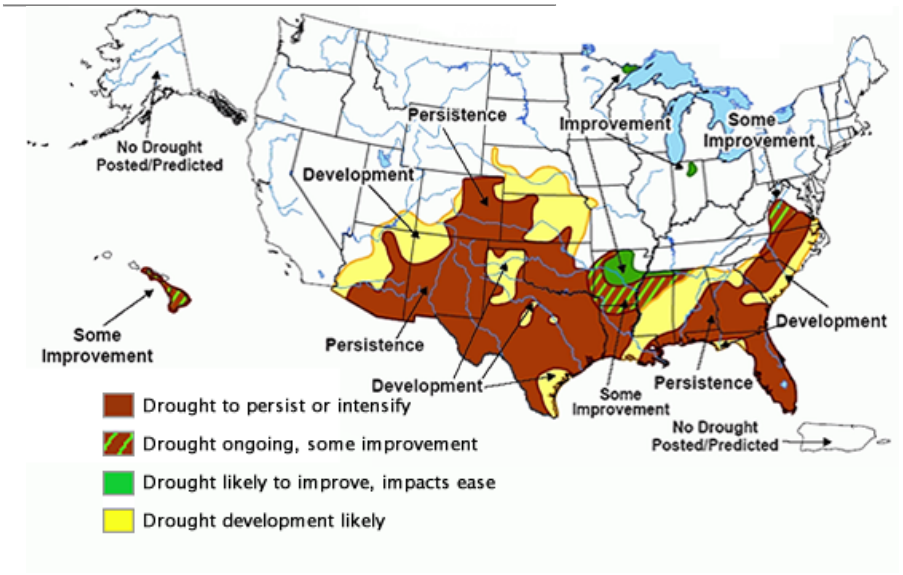

Figure DO-1. Seasonal Drought Outlook for March 17ÐJune 2011. (Source: NOAA Climate Prediction Center)

Notes & Weblinks

(provides explanations of graphics and additional information sources)

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