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INTERMOUNTAIN WEST CLIMATE SUMMARY

A product of the Western Water Assessment

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May 2010 Summary

Temperature — *In April 2010, temperatures were generally near average across the region, with only scattered areas experiencing anomalies greater than 2iF above or below average.*

Precipitation — *Storm tracks finally shifted to the north in April, bringing above-average precipitation across much of northern Colorado and Utah, along with parts of southern Wyoming, but leaving southeastern Utah unusually dry for the month.*

Hydrological Conditions — *The April moisture in the northern part of the region was "too little, too late", and forecasted streamflows for the springÐsummer runoff season are still below average in nearly every basin across the region.*

ENSO — *The current El Ni–o event is transitioning to ENSO-neutral conditions, with the tropical Pacific shifting from warmer-than-average to average sea surface temperatures. The wet influence of El Ni–o on the region's weather this spring is tapering off as well.*

Climate Forecasts — *For June and subsequent seasons, the CPC seasonal outlooks call for an enhanced risk of warmer-than-average temperatures for the southern and western parts of the Intermountain region, and an enhanced risk of above-average precipitation for eastern Colorado and eastern Wyoming.*

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Announcements & News

WWA Advisory Board Meeting
April 28-29, 2010, Boulder, CO

Last month, WWA held its first Advisory Board meeting. The WWA Advisory Board, created in 2009, consists of 13 members representing water utilities, state and federal resource management agencies, federal research labs, environmental NGOs, and NOAA. Their role is to help WWA direct its resources to best serve the needs of its stakeholders and NOAA. Additional stakeholders from federal, state, and local entities also attended the meeting, at which WWA team members presented their projects and activities, interspersed with lively discussion. The Advisory Board and other meeting participants provided a strong affirmation of WWA's current direction: to provide a broad range of decision-support climate products, tools, and assessments to diverse stakeholders in all three states in the region.

Drought Preparedness for Tribes in the Four Corners Region Workshop

April 8-9, 2010, Flagstaff, AZ

Also last month, the National Integrated Drought Information System (NIDIS), National Drought Mitigation Center (NDMC), Western Water Assessment, and the Climate Assessment of the Southwest (CLIMAS) convened a workshop focusing on drought and climate concerns among Native Nations in the southwestern US. Workshop participants included representatives from the Southern Ute, Navajo, Hopi, Hualapai, Havasupai, and Tohono O'odham Nations, and mutliple federal agencies, universities, and the Institute for Tribal Environmental Professionals (ITEP). This workshop was aimed at identifying and prioritizing critical drought early warning and information needs, and forming long-term partnerships between regional Tribes and federal and state partners. The workshop webpage, hosted by WWA, can be found here.

WWA-CBRFC Streamflow Forecast Workshop
April 23, 2010, Grand Junction, CO

WWA, with CLIMAS and the NOAA NWS Colorado Basin River Forecast Center (CBRFC) in Salt Lake City, presented a one-day workshop for potential users of the online Water Resources Outlook tool developed by CBRFC to provide user-friendly access to streamflow forecast data for individual forecast points across the western US. The workshop sessions were designed to both educate participants about the tool and the forecasts, and solicit feedback to improve the tool. Water planning scenarios were discussed in small groups to gain a better understanding of what climate and hydrologic information is useful under varying water supply conditions. The new Water Supply Outlook tool can be accessed here. The workshop web page, with the agenda and other information, is here.

Upcoming: WWA-CBRFC Streamflow Forecast Workshop
August 2010, Salt Lake City, UT

A workshop on the new CBRFC Water Supply Outlook tool, similar to the one held in Grand Junction, will be held in August 2010 in Salt Lake City; please contact us at wwa@noaa.gov to be added to the mailing list when the workshop date is announced.

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Feature Article

Impacts of the mountain pine beetle infestation on the hydrologic cycle and water quality: A symposium report and summary of the latest science

By Jeff Lukas and Eric Gordon (WWA)

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Focus Article

Weekly Climate, Water and Drought Assessment for the Upper Colorado Basin: A new webinar series from the Colorado Climate Center and NIDIS

By Christina Alvord (WWA) and Wendy Ryan (Colorado Climate Center)

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Recent Climate Conditions

Average temperatures for April ranged from below 30iF in high-elevation mountain regions to 55iF and above in parts of southern **Utah** (Figure RC-1). Across much of **Colorado** and eastern portions of **Wyoming** and **Utah**, along with parts of northwestern **Wyoming**, temperatures were up to 2iF higher than normal. Parts of southeastern **Colorado** and **Utah** observed temperatures up to 4iF above normal. Areas in western and central **Utah** and southern **Wyoming** saw temperatures up to 4iF below normal.

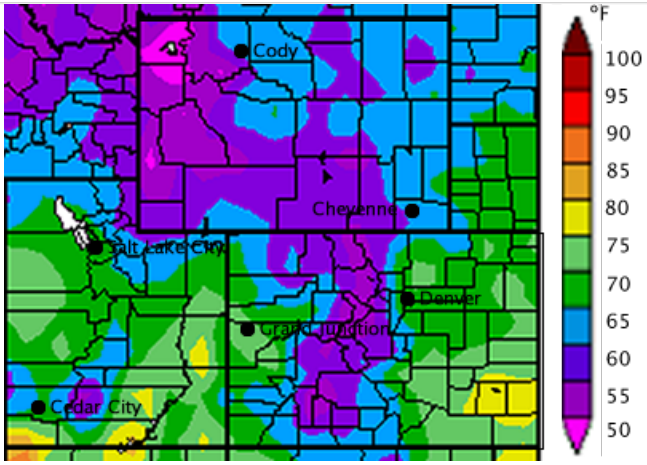

Figure RC-1. Average temperature for the month of April 2010 in iF. (Source: High Plains Regional Climate Center)

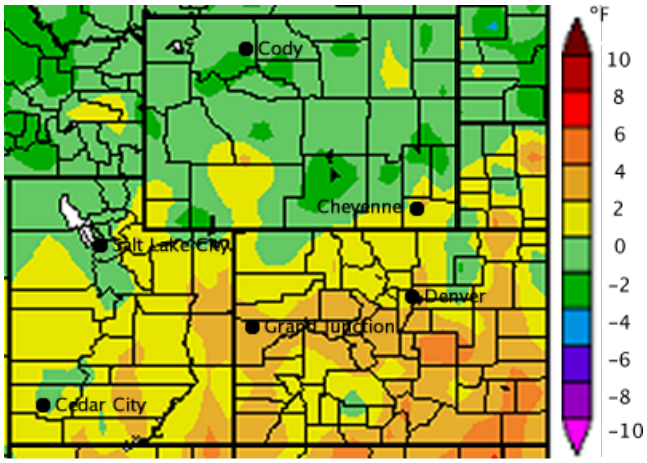

Figure RC-2. Departure from average temperature for the month of April 2010 in iF. (Source: High Plains Regional Climate Center)

Location	Record	New Record	Old Record	Year
April 1				
Casper, WY	Total Daily Precipitation	0.26	0.17	1984
April 11				
Alta, UT	High Min Temperature	38	32	1992
Salt Lake City Airport, UT	High Min Temperature	52	52	1985
Tooele, UT	High Min Temperature	58	54	1916
April 12				
Colorado Springs, CO	High Max Temperature	77	76	2006
Pueblo, CO	High Max Temperature	83	83	2003
April 20				
Salt Lake City Airport, UT	High Min Temperature	55	53	1980
April 23				
Laramie, WY	Daily Max Rainfall	0.39	0.34	1983

Worland, WY	Low Min Temperature	23	24	1988
Casper, WY	Low Min Temperature	17	17	1988
April 24				
Cheyenne, WY	Daily Max Rainfall	1.24	1.13	1905
Laramie, WY	Daily Max Rainfall	0.60	0.59	2003
April 28				
Bryce Canyon Airport, UT	High Min Temperature	44	35	1983
Hanksville, UT	High Min Temperature	60	57	2003
April 30				
Alpine, UT	Low Max Temperature	45	51	1983
Bountiful Val Verda, UT	Low Max Temperature	45	45	1990
Bullfrog, UT	Low Max Temperature	53	55	1990
Price, UT	Low Max Temperature	46	50	1970

Table RC-1. Record temperature and precipitation events in the Intermountain West during April 2010. (Source: NOAA National Weather Service)

Unlike storm tracks earlier in the winter season, which favored southern **Utah** and southern **Colorado**, April saw above-average precipitation across much of northern **Colorado** and northern **Utah**, along with parts of southern **Wyoming** (figures RC-3 and RC-4). Much of southeastern **Utah** was abnormally dry, receiving less than 40% of normal precipitation for the month. Precipitation was also below average in southeastern **Colorado** and parts of northeastern and central **Wyoming**.

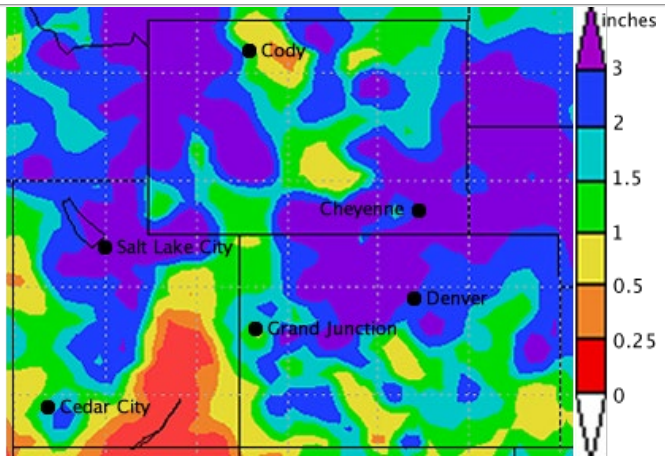

Figure RC-3. Average precipitation for the month of April 2010 (inches). (Source: NOAA ESRL Physical Science Division)

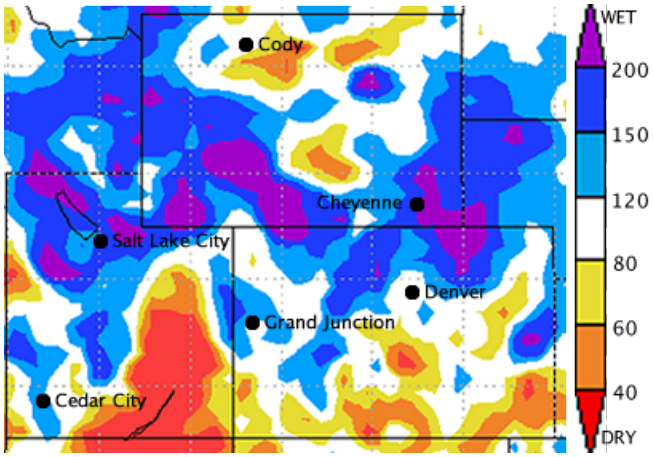

Figure RC-4. Percent of average precipitation for the month of April 2010. (Source: NOAA ESRL Physical Science Division)

The 3-month SPI (figure RC-5) shows a marked departure from recent months. Areas in eastern **Colorado** have become moderately wet, while previously dry areas in southwestern **Wyoming** and western **Utah** are now near normal. Southeastern **Wyoming** is now categorized as very wet. The 36-month SPI (figure RC-6) shows near-normal conditions throughout much of **Colorado** and **Utah**, with moderately dry conditions across western **Utah** and western **Wyoming**. Portions of eastern **Wyoming** and eastern **Colorado** are considered moderately wet.

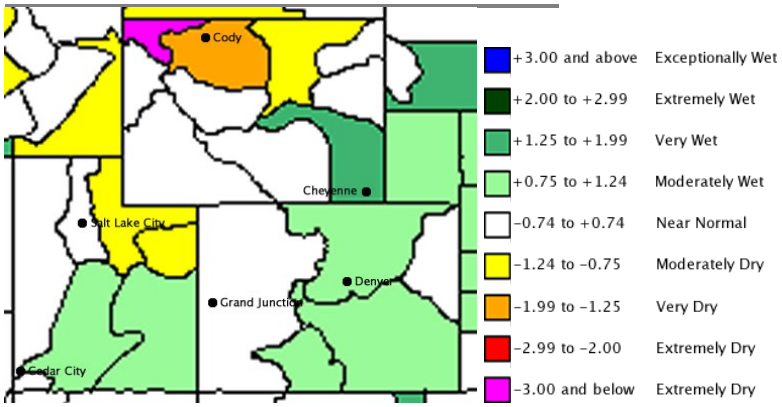

Figure RC-5. 3-month Intermountain West regional Standardized Precipitation Index as of the end of April 2010 (data from 2/01/10Ð 4/30/10). (Source: Western Regional Climate Center)

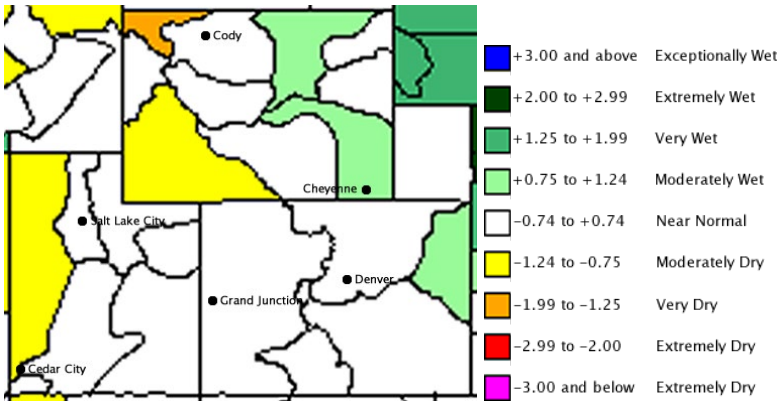

Figure RC-6. 36-month Intermountain West regional Standardized Precipitation Index as of the end of April 2009 (data from 05/01/07Ð4/30/10). (Source: Western Regional Climate Center)

In the U.S. Drought Monitor for mid-May, the above-average precipitation in northern and central **Wyoming** led to a reduction in the area of abnormally dry conditions compared with last month. But moderate to severe drought continues to affect western **Wyoming**, while abnormally dry conditions persist across northern **Utah,** central **Wyoming**, and northwestern **Colorado** (Figure RC-7).

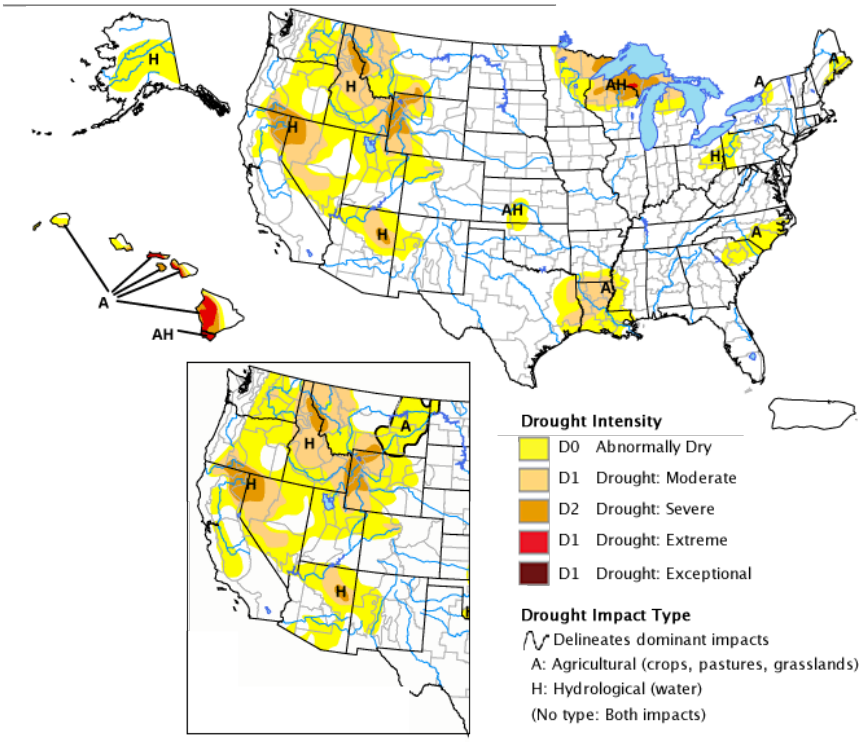

Figure RC-7. Drought Monitor from May 18, 2010 (full size) and April 20, 2010 (inset, lower left) for comparison. (Source: National Drought Mitigation Center)

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Intermountain West Snowpack

The persistent north-south gradient in snowfall reversed itself in April, with below-average snowfall in central **Wyoming** and southern **Utah** and **Colorado** and above-average amounts in northern basins in **Utah** and **Colorado** extending into the Cheyenne and Belle Fourche River basins in **Wyoming**. Still, May 1 snowpacks are below average across the Intermountain West, with the exception of near- and above-average snowpacks in eastern pockets of **Wyoming** and southern **Utah** (Figure SP-1).

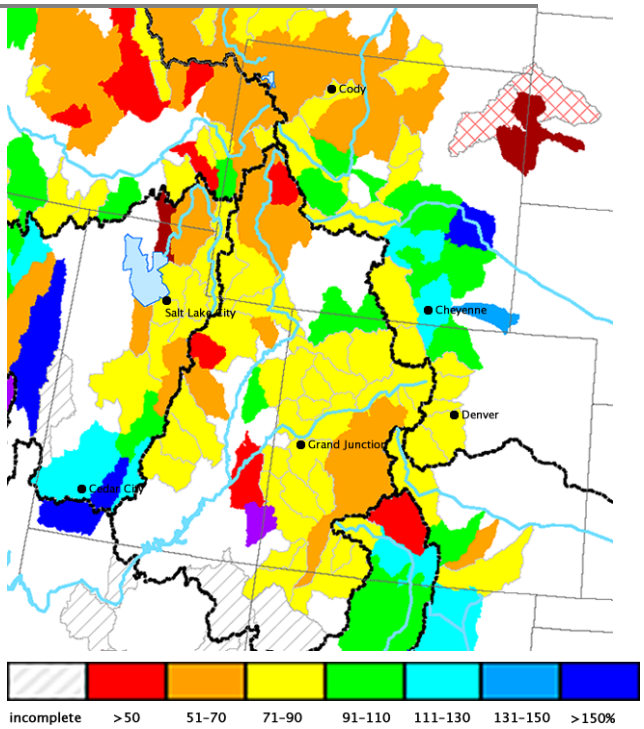

Figure SP-1. Snow water equivalent (SWE) as a percent of average for available SNOTEL and snow course sites, calculated for each basin in the Intermountain West as of May 1, 2010. (Source: Natural Resource Conservation Service)

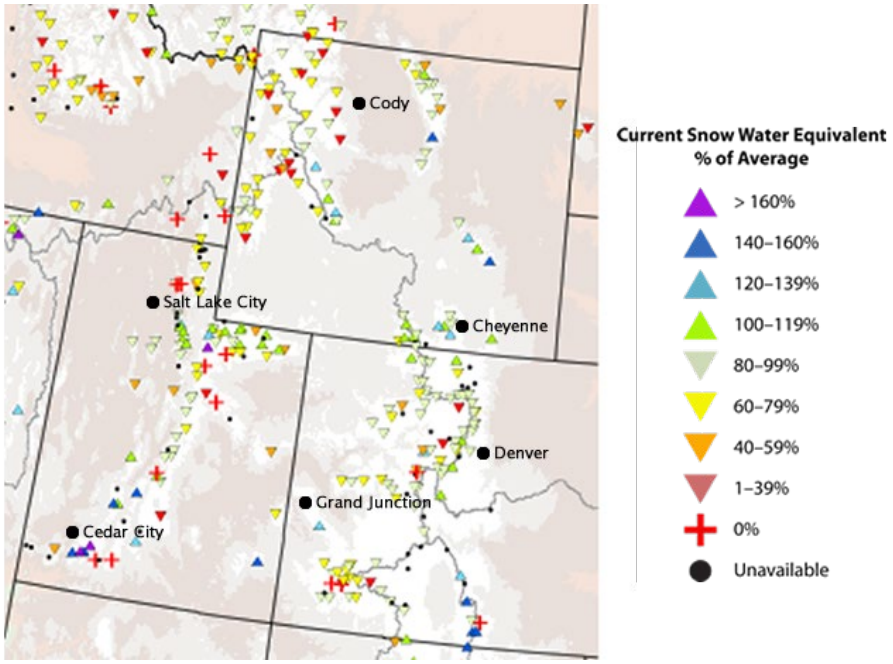

Figure SP-2. Current snow water equivalent (SWE) as a percent of average for SNOTEL sites as of May 5, 2010 (Source: Natural Resources Conservation Service).

In **Colorado**, warming temperatures in late April triggered widespread snowmelt. May 1 snowpacks range from a low of 71% of average in the Colorado River basin to a high of 90% of average in the Rio Grande basin. However, April storms did bring above-average snowfall across northern basins, increasing Yampa and White River basins snowpack to 83% of average, the highest percentage all winter.

In **Utah**, May 1 snowpacks in northern basins range from 60Ð80% of average, while southern basins range from 100Ð160% of average. Large storms in the first week of April in northern basins contributed one-third of the total winter snowfall, but only partially alleviated the extreme below-average streamflow forecasts for these basins.

In **Wyoming**, May 1 snowpacks are 76% of average statewide. April precipitation varied across the state, but was mainly below average, ranging from a low of 39% of average in the Green River basin to a high of 135% of average in the Belle Fourche and Cheyenne River basins. Snowpacks range from 50Ð70% of average in northern, central and western basins, and are highest in the eastern basins, ranging from 90Ð109% of average (Figure SP-2).

Update: As of May 20, snowpack as percent-of-average has generally increased since May 1 across the Intermountain West, with the exception of southwestern **Colorado** and a few basins in central **Utah**, due to cool temperatures and heavy snowfall in the first two weeks of May. Note that this late in the season, when many low-elevation sites have melted out, basin snowpack averages are not as reliable. In **Colorado**, with several additional dust-on-snow events since early April, the total extent and intensity of dust deposition for the 2010 season is approaching that of 2009. (For more information on dust-on-snow events, see the CODOS program page at the Center for Snow and Avalanche Studies.)

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Spring and Summer Streamflow Forecasts for the 2010 Runoff Season

As of May 1, streamflow projections for the summer runoff season are below average across most of **Wyoming**

and **Utah** and northern and western **Colorado,** and near or above average in southern basins throughout the Intermountain West (Figure STRM-1). Above-average precipitation in the first half of April for most of the Intermountain West region led to some increases in projected streamflow since April 1.

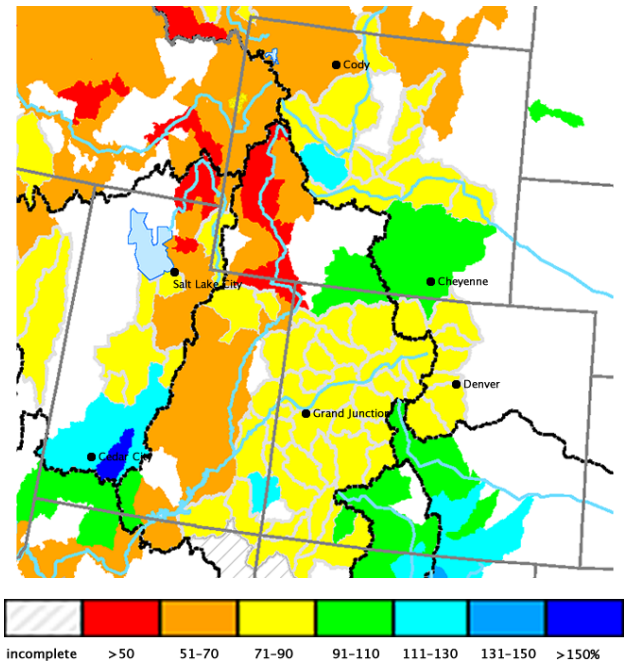

Figure STRM-1. NRCS outlook for natural streamflows for spring and summer in the Intermountain West region as a percent of average streamflows as of May 1, 2010. (Source: Natural Resource Conservation Service)

In **Colorado**, above-average precipitation brought moisture to the driest, northern, basins of the state, but did not significantly improve streamflow forecasts. The lowest streamflow forecasts are for the Yampa and Colorado River basins, ranging from 50Ð75% of average, and the highest are for the Arkansas and Rio Grande basins, ranging from 85Ð110% of average. Below-average precipitation in March and April has reduced forecasted streamflows for the combined San Juan, Animas, Dolores and San Miguel basins, with May 1 forecasts ranging from 70%Ð90% of average.

In **Wyoming**, May 1 streamflow projections are below average (50%Ð80% of average) across most of the state. Cheyenne and Belle Fourche basins have the highest streamflow forecasts, at 94% of average. The lowest streamflow projections are for the Green River basin, at 41% of average.

Forecasted summer streamflows vary widely across **Utah**, and generally reflect a north-south gradient with the lowest streamflow projections in northern basins (59% of average for Bear River) and highest projections in southern basins (156% of average for the Sevier River). The April-July inflow forecast into Lake Powell is 66% of average as of May 1.

[The majority of the text on this page comes from the NRCS State Basin Outlook Reports: http://www.wcc.nrcs.usda.gov/cgibin/bor.pl.]

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Reservoir Supply

Reservoir storage throughout the Intermountain West is typically lowest at the beginning of May in preparation for inflows from spring runoff. The above-average reservoir storage throughout the Intermountain West will help supplement water supplies given the below-average streamflows expected for the 2010 runoff season in almost all basins.

	current water	% of

	reservoir	level (af)	capacity (af)	% full	average	average
COLORADO	Dillon Reservoir	238,321	257,304	93%	257,304	93%
	Turquoise Lake	59,445	129,390	46%	70,605	84%
	Lake Granby	347,927	539,758	64%	296,104	118%
	Blue Mesa	568,443	829,500	71%	404,700	145%
	Pueblo	252,400	235,000	107%	163,500	154%
UTAH	Strawberry	960,400	1,106,500	89%	663,700	148%
	Utah Lake	865,000	870,900	99%	872,600	99%
	Bear Lake	476,700	1,302,000	37%	971,000	49%
	Lake Powell	13,895,053	24,322,000	57%	17,551,000	79%
WYOMING	Fontenelle	125,415	344,800	36%	143,500	87%
	Flaming Gorge	3,228,349	3,749,000	86%	2,952,000	109%
	Seminoe	726,411	1,017,273	71%	463,140	157%
	Boysen	611,725	741,594	82%	485,068	126%
	Buffalo Bill	398,090	644,126	62%	374,462	106%

Figure RES-1. All reservoir content data is from April 30ÐMay 1, 2010. Percent of average ranges are color coded as follows: green: 80Ð100%; light green: 60Ð79%; yellow: 40Ð59%; orange: 20Ð39%; red: 0Ð19%.

Early runoff during April yielded significant improvements in reservoir storage across **Colorado**. All basins with the exception of the Rio Grande are reporting above-average reservoir storage. Statewide reservoir storage at its highest since 2000, at 108% of average. The AprilÐJuly reservoir inflow projections for the Colorado reservoirs in Figure RES-1 range from 73Ð97% of average .

In **Wyoming**, reservoir storage is 116% of average statewide and will help offset forecasted below-average summer streamflows. Reservoir storage is above to well above average for the five reservoirs listed in Figure RES-1, with the exception of Fontenelle, at 87% of average. April-July inflow forecasts for Fontenelle reservoir increased slightly since last month and are now projected at 47% of average, and Flaming Gorge AprilÐJuly inflow is expected to be 43% of average.

Storage in 41 of **UtahÕs** key irrigation reservoirs is at 73% of capacity as of May 1, up 3% from this time last year. April inflow into Lake Powell was 95% of average, well above that projected on April 1. But the projected inflow for the full AprilÐJuly period for Lake Powell is 66% of average, or 5.2 million acre-feet.

[The majority of the above text comes from the NRCS State Basin Outlook Reports: http://www.wcc.nrcs.usda.gov/cgibin/bor.pl.]

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ENSO Status and Forecast

Sea-surface temperature warm anomalies across the tropical Pacific continued to decrease sharply since March, with cool anomalies emerging along the equator in the eastern and central Pacific, and a transition from El Ni–o to ENSO-neutral conditions is now underway, with an ENSO-neutral state exected by June (Figure EN-1).

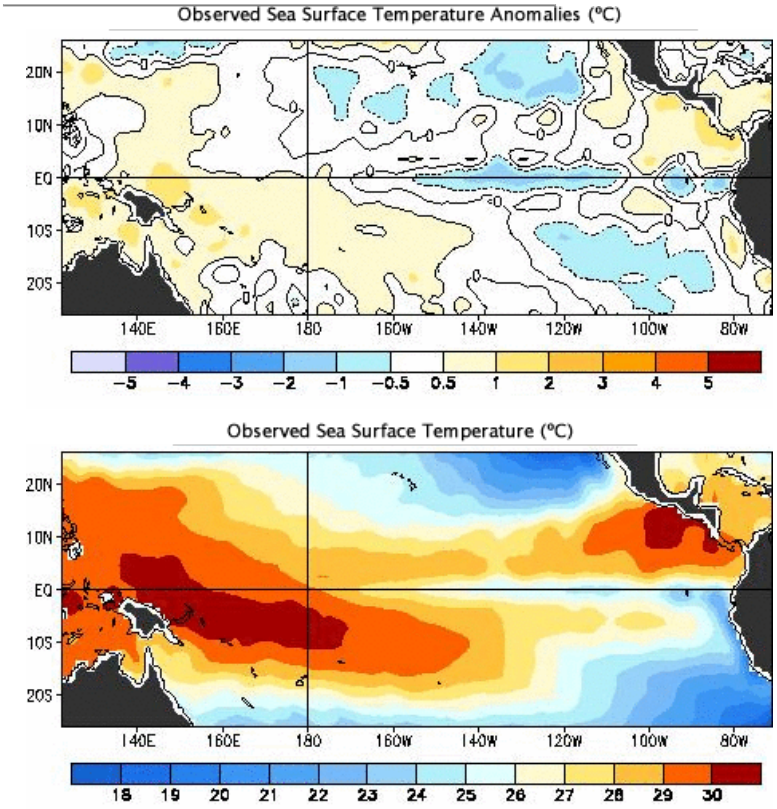

Figure EN-1. Observed SST anomalies (upper) and Observed SST (lower) in the Pacific Ocean. The Ni–o 3.4 region encompasses the area between 120iWÐ170iW and 5iNÐ5iS. The graphics represent the 7-day average centered on May 19, 2010. (Source: NOAA Climate Prediction Center)

Across a broad set of dynamical and statistical ENSO forecast models, over 80% indicate ENSO-neutral conditions will develop and persist during the MayÐJuly period in progress (Figure EN-2). There is disagreement among models about whether the ENSO state during the second half of 2010 will remain ENSO-neutral or become that of a weak or moderate La Ni–a. Most of the dynamical models (closed circles) project the development of a La Ni–a by the fall. Probabilities for returning to El Ni–o are very small through the forecast period.

The NOAA ENSO Diagnostic Discussion will be updated on the first Thursday of June 2009.

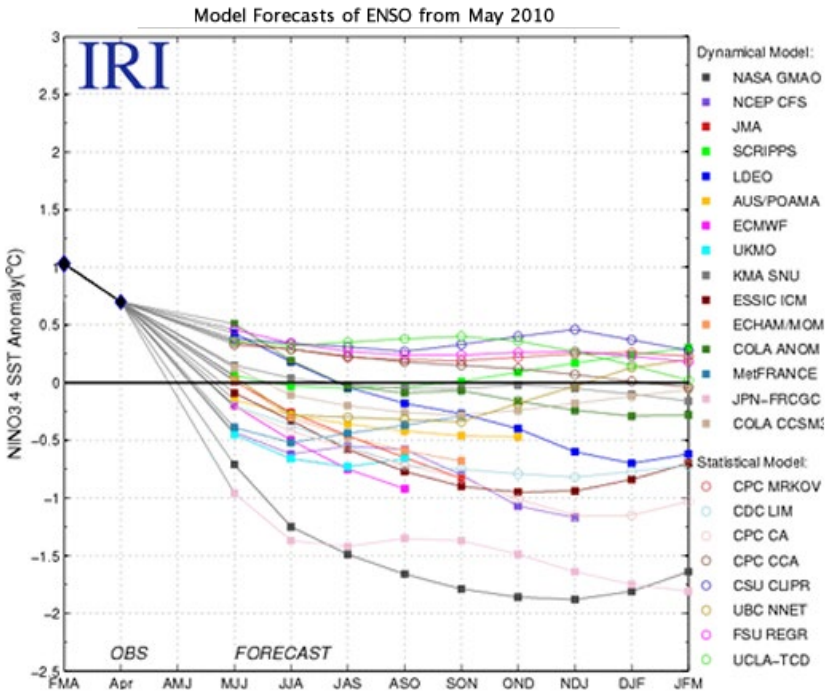

Figure EN-2. Forecasts made by dynamical and statistical models for sea surface temperatures (SST) in the Ni–o 3.4 region for nine overlapping 3-month periods from MayÐJuly 2010 to JanuaryÐMarch 2011 (released May 20, 2010). (Source: International Research Institute (IRI) for Climate and Society)

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Temperature Outlook
June–October 2010 (Released May 20, 2010)

The latest temperature outlooks from the NOAA Climate Prediction Center indicate an enhanced risk of above-average temperatures for the interior western US, in June 2010 and subsequent seasons (Figures TEMP-1 to TEMP-4). This region of likely warmer-than-average temperatures extends mainly into the western and southern portions of the Intermountain West, with the most enhanced risk of warming seen for southern **Utah** and southwestern **Colorado**. Given the expected ENSO-neutral conditions during these periods, the enhanced risk of warming mainly reflects the pronounced long-term warming trend over the interior West.

Note: These climate outlooks are intended for use prior to the start of their valid period (in this case, prior to the beginning of June). Within any given valid period, observations and NWS short- and medium-range forecasts should be consulted. The June 2010 temperature forecast will be updated on May 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 June 17th.

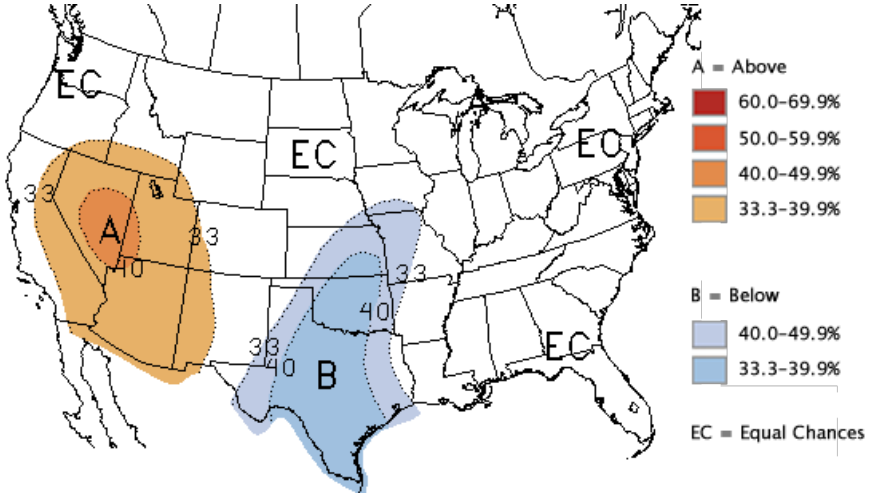


Figure TEMP-1. Long-lead national temperature forecast for June 2010. (Source: NOAA Climate Prediction Center)

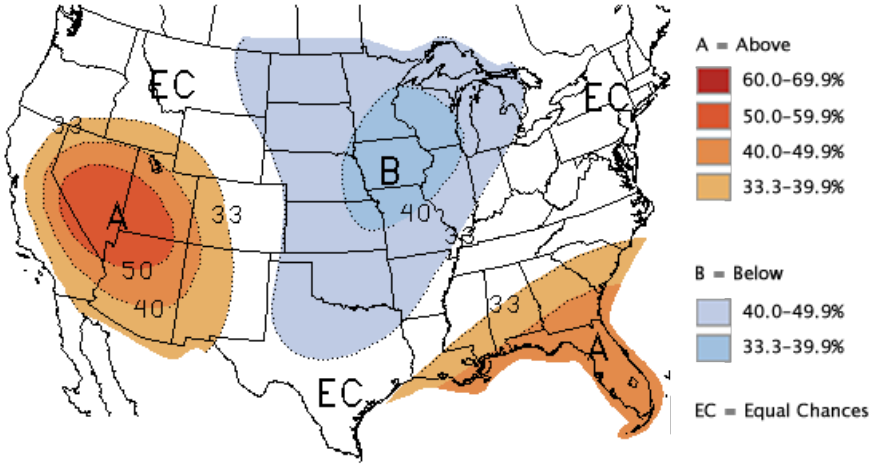
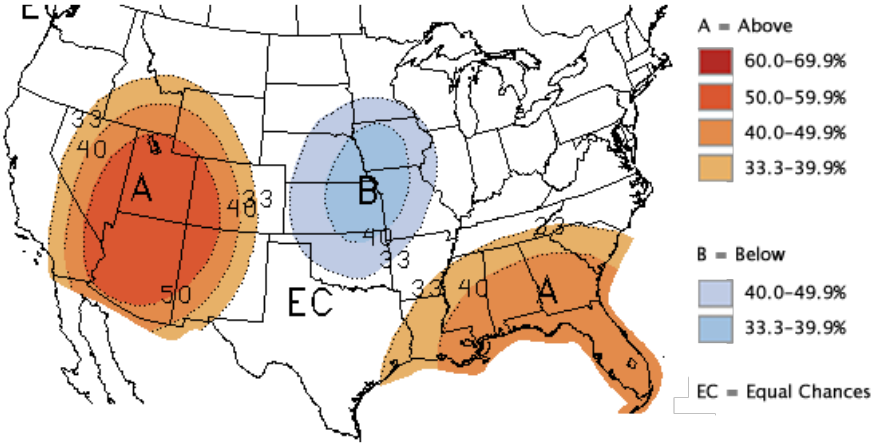


Figure TEMP-3. Long-lead national temperature forecast for JulyÐSeptember 2010. (Source: NOAA Climate Prediction Center)



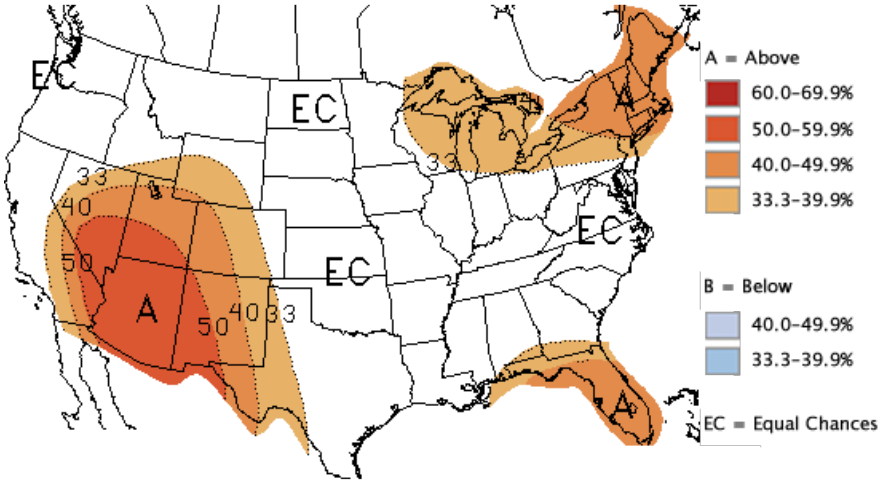


Figure TEMP-4. Long-lead national temperature forecast for AugustÐOctober 2010. (Source: NOAA Climate Prediction Center)

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Precipitation Outlook
June–October 2010 (Released May 20, 2010)

The CPC precipitation outlook for June 2010 (Figure PPT-1) shows an enhanced risk of above-average precipitation over the southern Great Plains region. For the subsequent JuneÐAugust, JulyÐSeptember, and AugustÐOctober seasons, the area of enhanced risk of wetter-than-average conditions shifts to the north, covering portions of eastern **Colorado** and eastern **Wyoming** (Figures PPT-2, PPT-3, and PPT-4). With the ENSO state now moving towards neutral conditions, these outlooks for a tendency for summer wetness over the Plains reflect a recent trend towards wetter summer and fall seasons over this region.

Note: these climate outlooks are intended for use prior to the start of their valid period (in this case, prior to the beginning of June). Within any given valid period, observations and NWS short- and medium-range forecasts should be consulted. The June 2010 precipitation forecast will be updated on May 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 June 17th.

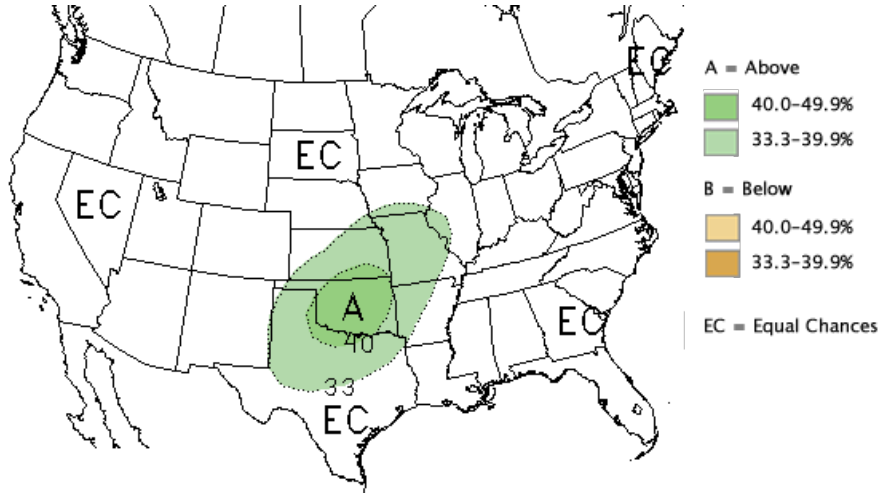

Figure PPT-1. Long-lead national precipitation forecast for June 2010. (Source: NOAA Climate Prediction Center)

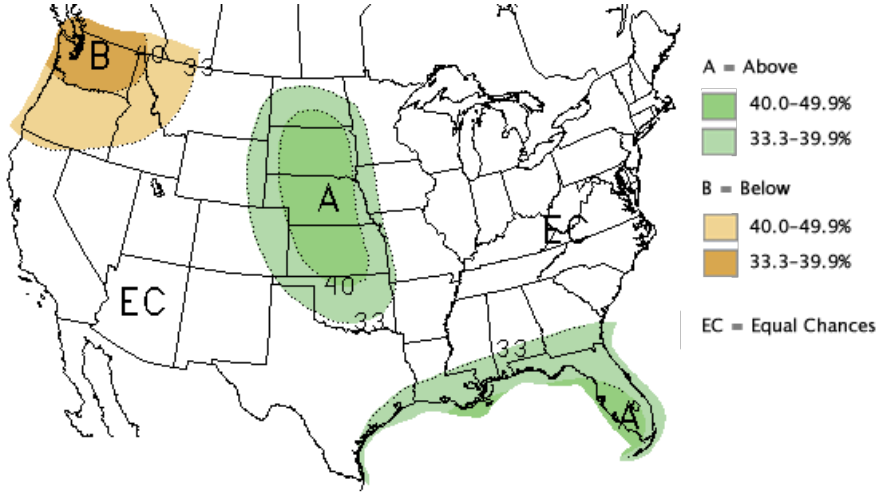

Figure PPT-2. Long-lead national precipitation forecast for JuneÐAugust 2010. (Source: NOAA Climate Prediction Center)

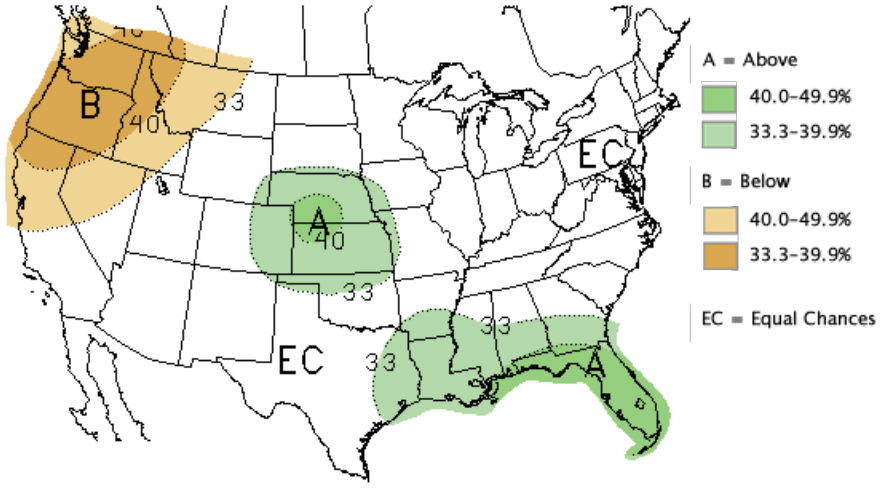

Figure PPT-3. Long-lead national precipitation forecast for JulyÐSeptember 2010. (Source: NOAA Climate Prediction Center)

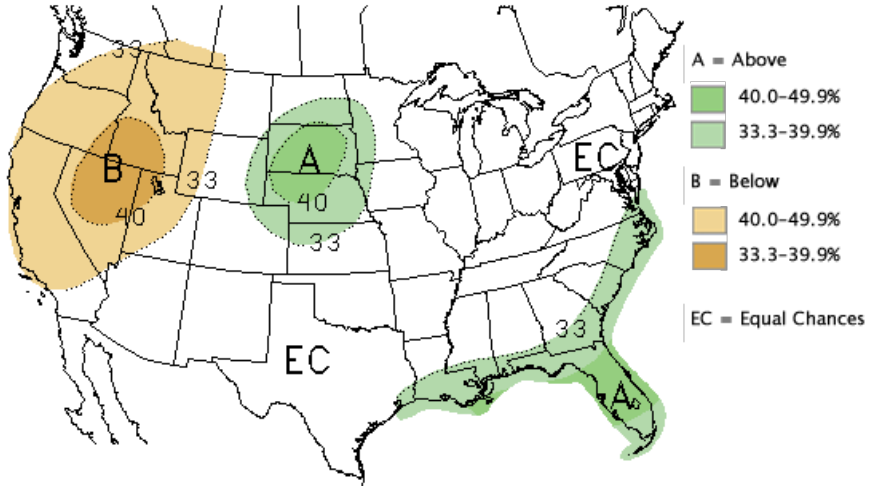

Figure PPT-4. Long-lead national precipitation forecast for AugustÐOctober 2010. (Source: NOAA Climate Prediction Center)

According to the experimental SWcast forecast guidance discussion, with the tapering off of El Ni–o's influence, the next two weeks (late MayÐearly June) look less favorable than the past month for an active storm track affecting **Colorado** and **Utah**. The guidance for the late summer season (JulyÐSeptember) shows a potential for

weaker-than-average monsoon precipitation in northwestern **Utah** and along the **Colorado** Front Range, while eastern **Colorado** has a better-than-average chance of a wet summer.

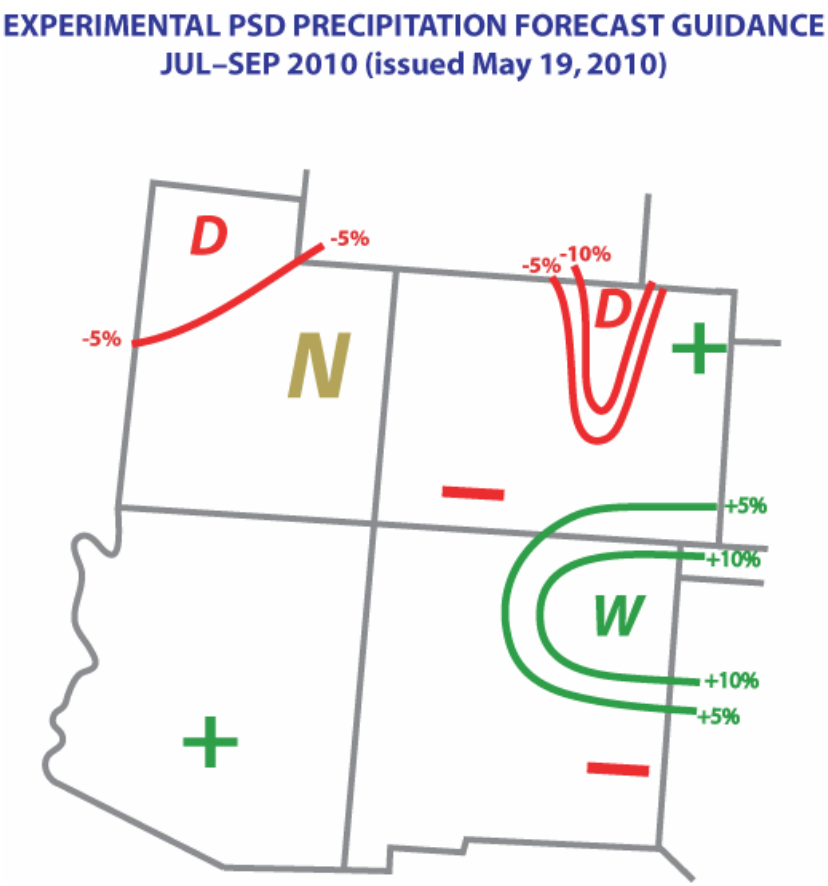

Figure PPT-5. Experimental precipitation forecast guidance. Forecasted shifts in tercile probabilities for JulyÐ September 2010. (Source: NOAA ESRL Physical Science Division)

Notes & Weblinks
(provides explanations of graphics and additional information sources)

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Seasonal Drought Outlook
through August 2010 (Released May 20, 2010)

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. The area of moderate (D1) and severe drought (D2) in western **Wyoming** and extreme northeastern **Utah** is expected to experience improvement through the summer, mainly as the result of wet weather forecasted to continue through late May (Figure DO-1). Improvement is also forecasted for the moderate drought in northern **Colorado**, with the expectation of helpful monsoonal rains.

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 June 1st.

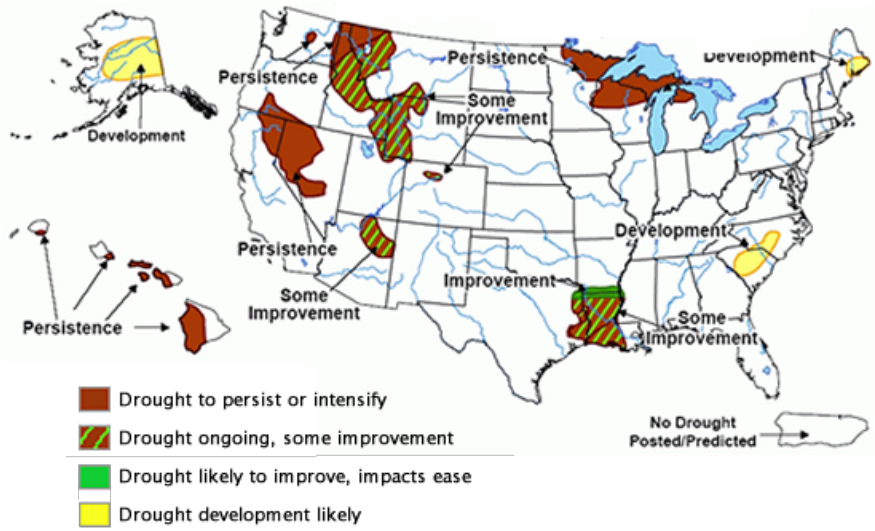

Figure DO-1. Seasonal Drought Outlook for May 20, 2010ÐAugust 2010. (Source: NOAA Climate Prediction Center)

Notes & Weblinks

(provides explanations of graphics and additional information sources)

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The Intermountain West Climate Summary is published periodically by Western Water Assessment (WWA), a joint project of the UNiversity of Colorado Cooperative Institute for Research in Environmental Sciences (CIRES) and the National Oceanic and Atmospheric Administration (NOAA) Earth System Research Laboratory (ESRL) researching water, climate, and societal interaction.

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