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INTERMOUNTAIN WEST CLIMATE SUMMARY

A product of the Western Water Assessment

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May 2011 Summary

Temperature — *April temperatures were below average across the entire region, with much of the region at least 4iF cooler than average.*

Precipitation — *Storm tracks continued to favor the higher parts of the region in western and south-central Wyoming, northern Utah, and western Colorado. Southeastern Colorado remained much drier than average.*

Hydrological Conditions — *The cool, wet April delayed melt and added to the snowpack across most of the regionÕs mountains, and very high spring-summer runoff and peak flows are forecast for northern Utah, northern Colorado, and south-central and western Wyoming.*

ENSO — *The current La Ni–a has continued to weaken and is transitioning to ENSO-neutral conditions by this summer.*

Climate Forecasts — *The temperature outlooks from the NOAA CPC indicate an enhanced risk of warmer-than-average temperatures in the southern part of the region in June and subsequent seasons. An enhanced risk of dry conditions is indicated for Wyoming in June and the summer season.*

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Announcements & News

Flooding likely in many locations in the Intermountain West during the runoff season

With above-average to record-high snowpacks in most parts of the region, and snow still accumulating at high elevations as of late May, high peak flows likely to cause flooding are forecasted in many basins across the region, particularly in northern Utah, northwest Colorado, and southwest Wyoming. Please monitor the peak flow forecasts and/or flood outlooks at the NOAA NWS River Forecast Centers for the Colorado Basin and Missouri Basin.

WWA/CBRFC Streamflow Forecast Workshop - Salt Lake City - June 21

Participants at this workshop will 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 streamflow forecast tool. Participants will also be able to provide opinions and insight directly to the developers so the RFC can improve the tool.

For more information and to register, go to the workshop web page.

CWCB Municipal Drought Planning Workshops - multiple Colorado locations - May and June

The Colorado Water Conservation Board (CWCB) is presenting several all-day interactive workshops around the state designed to help participants understand and use new and innovative resources for improved drought planning. Participants from both the public and private sectors are welcome. The remaining workshop dates and locations are June 2nd - Denver (full as of May 25); June 14th - Glenwood Springs; June 15th - Steamboat Springs; June 28th - Colorado Springs.

For more information and to register, go to the workshops web page at CWCB.

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Feature Article

The spring runoff roundup Ð another look at ENSO, dust-on-snow, beetles, and Lake Mead

By Jeff Lukas (WWA)

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Focus Article

There is no Focus Article in this issue.

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Recent Climate Conditions

April temperatures were below average across the entire region, with the largest cold departures (at least 4iF below average) over **Wyoming,** western **Colorado,** and a broad swath across **Utah** (Figure RC-2). The 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).

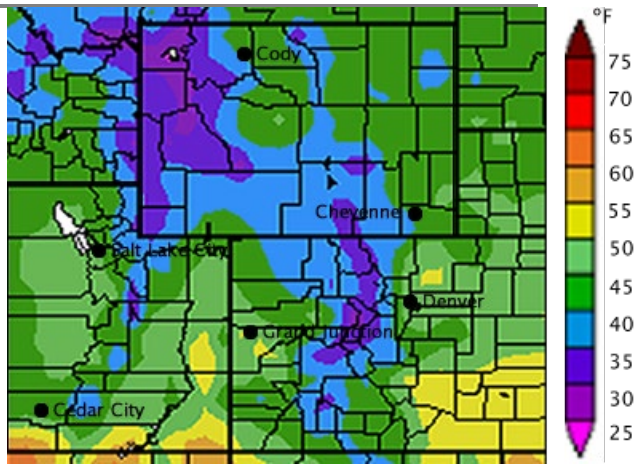

Figure RC-1. Average temperature for the month of April 2011 in iF. (Source: High Plains Regional Climate Center)

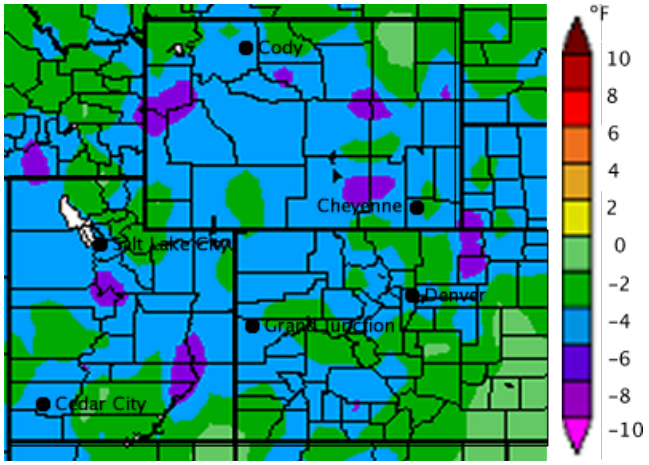

Figure RC-2. Departure from average temperature for the month of April 2011 in iF. (Source: High Plains Regional Climate Center)

The persistent and strong Pacific jet continued to favor the mountainous parts of the region in western and south-central Wyoming, northern **Utah,** and western **Colorado**, with April precipitation at least 150% of average in those areas (Figures RC-3 and RC-4a), boosting the already above- average snowpacks in those areas (Figures SP-1 and SP-2). Southeastern **Colorado** again missed out on this moisture and remained abnormally dry, receiving less than 40% of normal precipitation for the month. Precipitation was also well below average in parts of northeastern and central **Wyoming**, and southern **Utah**.

For the water year through April, most of **Utah**, southern **Wyoming**, and northwestern **Colorado** has seen above-average precipitation, while southeastern **Colorado** and northeastern **Wyoming** have been on the dry side (Figure RC-4b).

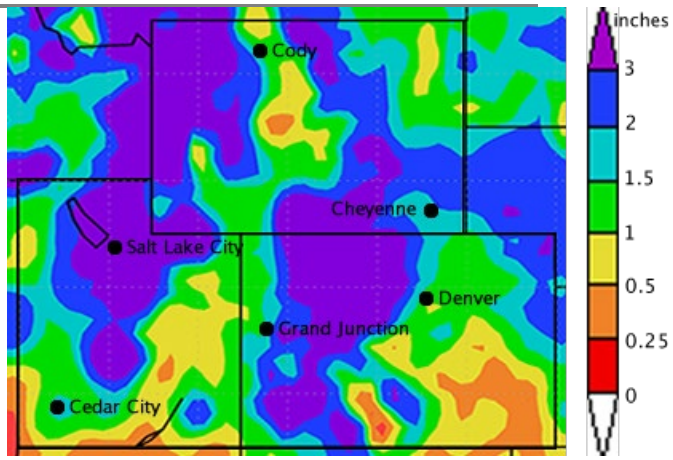

Figure RC-3. Average precipitation for the month of April 2011 (inches). (Source: NOAA ESRL Physical Science Division)

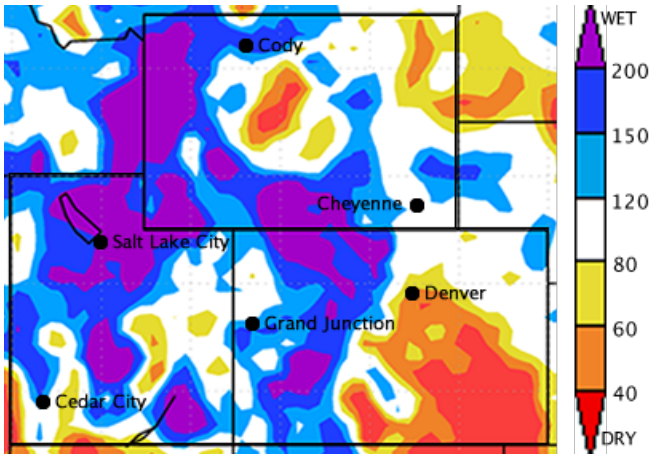

Figure RC-4a. Percent of average precipitation for the month of April 2011. (Source: NOAA ESRL Physical Science Division)

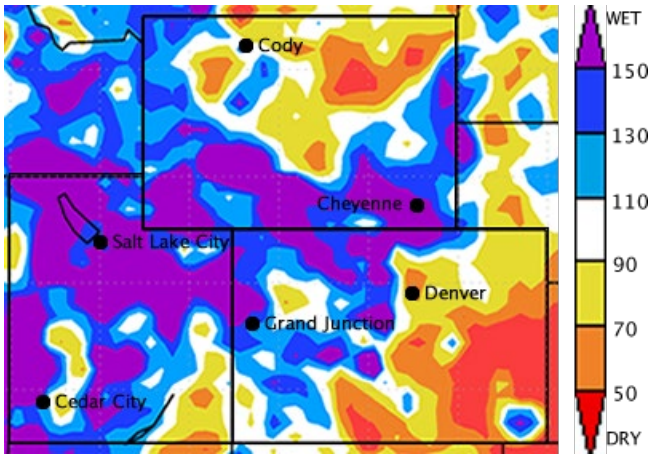

Figure RC-4b. Percent of average precipitation for October 2010ÐApril 2011. (Source: NOAA ESRL Physical Science Division)

Below-average precipitation in April (Figure RC-4a) in central **Wyoming** and southeastern **Colorado** was sufficient for moderately dry short-term conditions, according to the 3-month SPI (Figure RC-5). In the 36-month SPI (Figure RC-6), long-term dryness persists in far northwestern **Wyoming** and south-central **Colorado**.

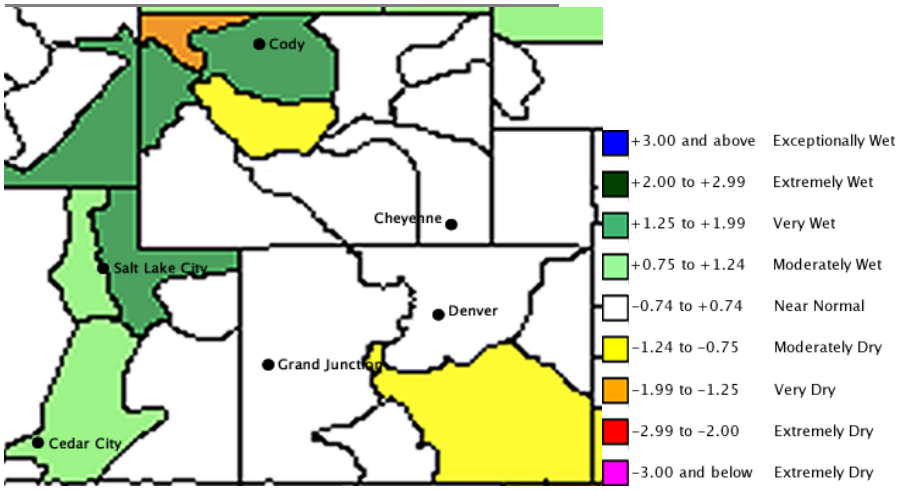

Figure RC-5. 3-month Intermountain West regional Standardized Precipitation Index as of the end of April 2011 (data from 2/01/11Ð 4/30/11). (Source: Western Regional Climate Center)

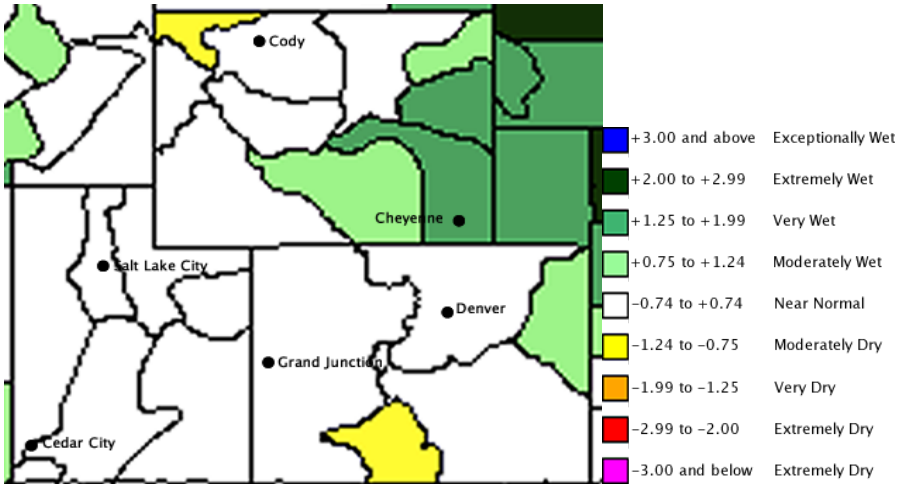

Figure RC-6. 36-month Intermountain West regional Standardized Precipitation Index as of the end of April 2011 (data from 05/01/08Ð4/30/11). (Source: Western Regional Climate Center)

In the U.S. Drought Monitor for mid-May, the average precipitation in northeastern **Colorado** led to a reduction in the area of severe drought (D2) conditions compared with last month. But the region of extreme drought (D3) in southeastern **Colorado** expanded due to the continued below-average precipitation there (Figure RC-7).

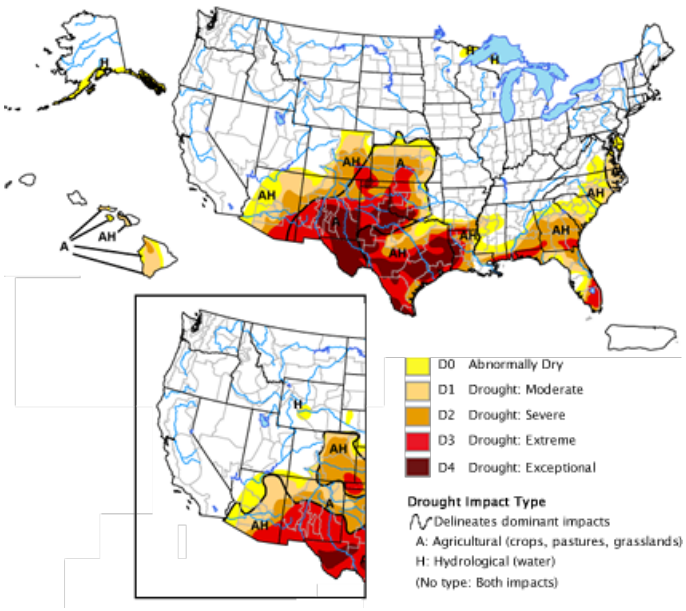

Figure RC-7. Drought Monitor from May 19, 2011 (full size) and April 26, 2011 (inset, lower left) for comparison. (Source: National Drought Mitigation Center)

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Intermountain West Snowpack

A cool, wet April delayed melt and added to the snowpack across most of the regionÕs mountains. As a result, May 1st snowpacks in the three-state region increased from the April 1st levels, and are much above average in all but southeastern **Utah** and southern **Colorado**. The most dramatic increases have been in **Wyoming**, northern **Utah**, and northern **Colorado** (Figure SP-1).

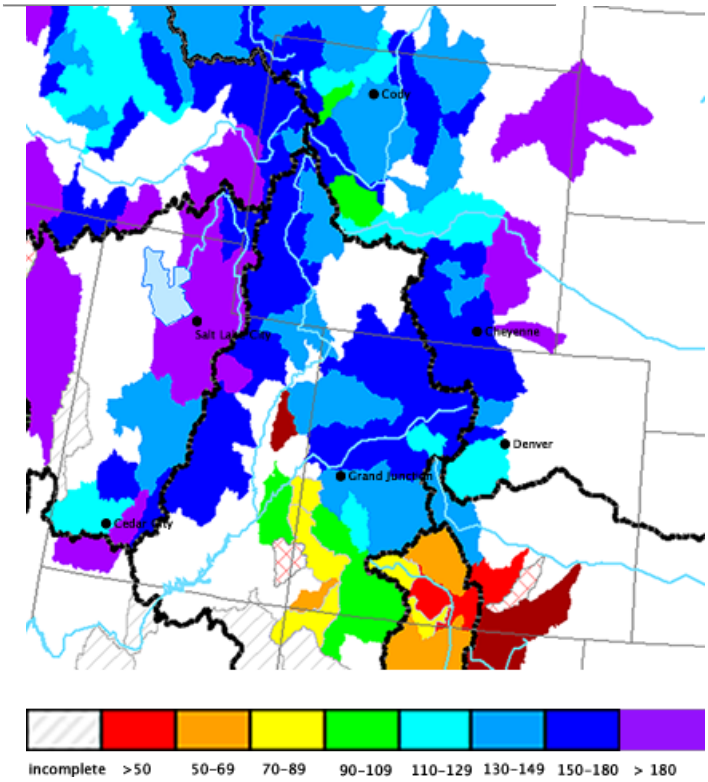

Figure SP-1. Snow water equivalent (SWE) as a percent of average for available SNOTEL and snow course sites, calculated for each basin in the Intermountain West as of May 1, 2011. (Source: Natural Resource Conservation Service)

In **Colorado**, May 1 snowpacks were above to much above average in all but the Upper Rio Grande Basin, which was below average at 72%, and the combined San Juan, Animas, Dolores, and San Miguel basins at 93% of average. New records for May 1 snow water equivalent were set at 46 sites, mostly in the North Platte, Cache La Poudre, Colorado, and Yampa basins. These northern basins reported 150 to 175% of average on May 1st, and the Yampa basin recorded a record May 1st snowpack at 175% of average. The statewide average was 136% of average. Water-year-to-May 1st precipitation was 122% of average statewide, and ranged from 91% of average on the Upper Rio Grande to 140% on the combined Yampa, White and North Platte.

Wyoming snowpacks were much above average in all basins as of May 1, with a statewide average of 157%. Individual basins ranged from 132% on the Wind River to 253% on the Belle Fourche. April precipitation was above to much above average across Wyoming, ranging from 106 to 229% of average. May 1 water-year-to-date precipitation was 100% to 162% of average.

The **Utah** statewide snowpack remained the highest in the three-state region at 167% of average, the highest May 1st measurement since 1983. The Bear River, Weber, and Provo basins all measured record May 1 SWE over 40 years of measurements, and many individual sites likewise had record May 1 SWE. Northern basins gained about as much snow in April as they would have lost during the month in a more typical year. Southern basins lost snow, but at a below-average rate. All basins recorded May 1st snowpacks above average, ranging from 144% in southeastern Utah to 210% for the Weber. May 1st water-yearÐto-date precipitation was above average in all basins, and 146% of average statewide.

Snowpack Update, May 20th: May has been very wet in **Utah** and much of **Wyoming**. **Colorado** has been wet in the northeast, and very dry in the southeast. Many high-elevation sites have continued to gain snowpack, while all major basins throughout the region have melted more slowly than average. This has led to some very high values for basin-average and SNOTEL-site snowpack throughout the region, most notably in northern **Utah** (Figure SP-2). The slow melt and wet spring has lead to an increased risk of very high peak flows in northern **Utah** and **Colorado**, as well as portions of **Wyoming**.

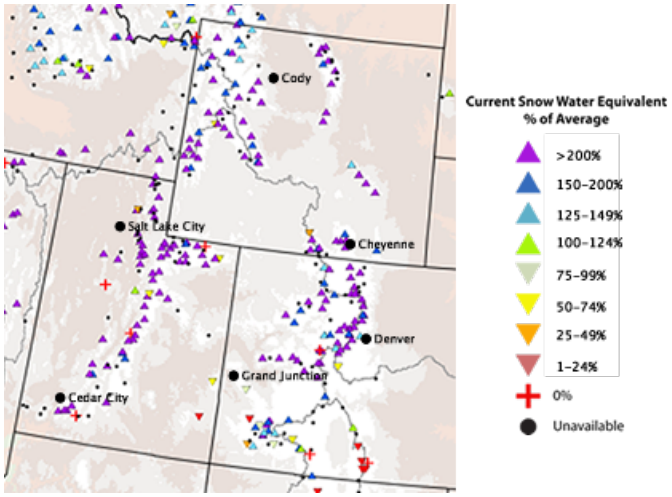

Figure SP-2. Current snow water equivalent (SWE) as a percent of average for SNOTEL sites as of May 19, 2011 (Source: Natural Resources Conservation Service).

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Spring and Summer Streamflow Forecasts for the 2011 Runoff Season

Spring and summer streamflow forecasts issued May 1 called for above to much above average runoff for nearly all of the Intermountain region. The only areas with below-average streamflow forecasted are southern **Colorado** and the southeastern corner of **Utah** (Figure STRM-1). The May to July inflow to Lake Powell was forecasted to be 151% of average. Since the April 1 streamflow forecasts were released, conditions have led to significant increases in forecasted flows in the already-wet areas, and also some modest increases in the drier regions.

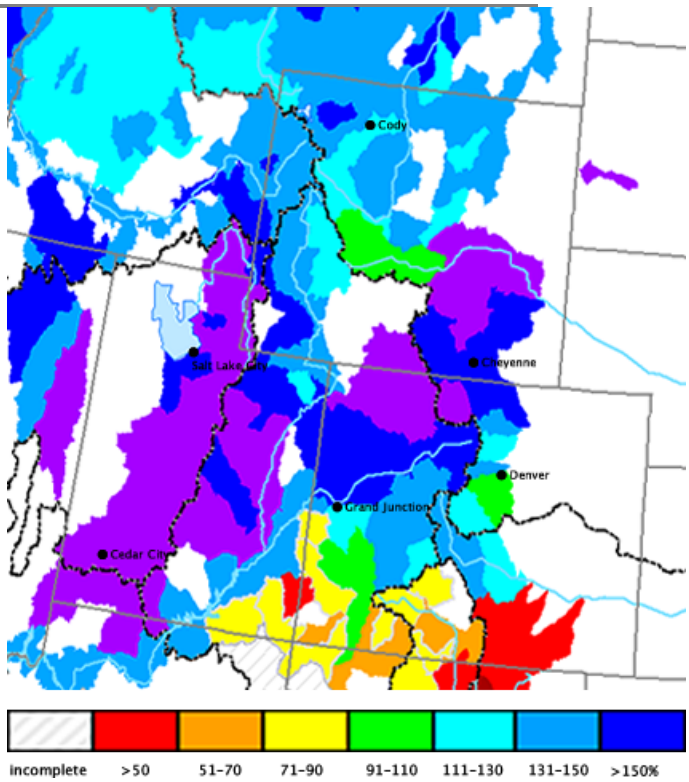

Figure STRM-1. NRCS outlook for natural streamflows for spring and summer in the Intermountain West region as a percent of average streamflows as of May 1, 2011. (Source: Natural Resource Conservation Service)

In **Colorado**, May 1 streamflow forecasts increased the gap between the dry south, and a very wet north. In the northwest basins, forecasts range from 150% to over 200% of average, for portions of the North Platte basins. In the Gunnison, South Platte and Arkansas headwaters basins, most forecasts range from 110% to 150% of

average. The lowest runoff forecasts in the state range from 21% to 50% of averageÐeven lower than last monthÐfor streams draining the Sangre de Cristo Mountains. Below-average runoff was also forecasted for most of southern Colorado, with the Rio Grande somewhat drier than the combined San Juan, Animas, Dolores, and San Miguel. Most forecasts in this region are in the range of 55% to 92% of average.

Wyoming May 1 streamflow forecasts are for above to much above average runoff for the major basins in the state, with a significant increase in most basins over last month. On the higher end, the Belle Fourche and Cheyenne Rivers are forecast at 245% and 269% of average, respectively. Statewide forecasted runoff os for 155% of average, with only a few forecast points in the state falling slightly below average.

Utah May 1 forecasts are for above to much above average streamflow throughout the entire state with only two exceptions. Most forecasts are in the 160% to 250% range, with very high flows anticipated at both north and south ends of the state. The highest flows are forecasted for the Sevier near Kingston, at 385% of average, and the lowest flows forecasted for the San Juan near Bluff, and South Creek near Monticello, at 75% and 50% of average respectively. A cool and wet spring has increased the potential for very high peak flows, most notably in northern Utah.

Streamflow Update, May 20th: The above-average precipitation thus far in May in many of the regionÕs mountains, especially central and southern **Utah**, western **Wyoming**, and northeastern **Colorado**, means that total spring and summer runoff may be yet higher than forecasted on May 1, and June 1 forecasts will likely reflect the continued wet conditions. Instantaneous streamflows on large streams around the region recorded on May 20th were above the long-term average at most gages in **Utah**, below average at most gages in **Colorado**, and evenly split above and below average across gages in **Wyoming**. Flows above the 90th percentile were prevalent in northern and southwest **Utah**; the southwest, southeast, and northeast corners of **Wyoming**; and northwest **Colorado**. Daily inflows to Lake Powell on May 19 averaged 42,153 cubic feet per second (CFS), roughly double the inflows on 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.This year, with much-above-average runoff forecasted in many basins, reservoirs have been drawn down to lower levels than is typical to make room for the inflows. Thus, the generally near-average storage conditions across the region as of May 1 will see a substantial boost by the end of the runoff season. The very large reservoirs in the region, such as Lake Powell and Bear Lake, that have been chronically depleted, are expected to see large gains in storage.

	reservoir	current water level (af)	capacity (af)	% full	average	% of average
COLORADO	Dillon Reservoir	197,596	257,304	77%	212,600	93%
	Turquoise Lake	53,175	129,390	41%	70,605	75%
	Lake Granby	355,820	539,758	66%	296,104	120%
	Blue Mesa	474,301	829,500	57%	404,700	117%
	Pueblo	262,190	354,000	78%	163,600	160%
UTAH	Strawberry	976,300	1,106,500	88%	663,700	147%
	Utah Lake	936,500	870,900	108%	872,600	107%
	Bear Lake	589,700	1,302,000	45%	971,000	61%
	Lake Powell	12,926,000	24,322,000	53%	17,551,000	74%
WYOMING	Fontenelle	117,580	344,800	83%	143,600	105%
	Flaming Gorge	3,095,330	3,749,000	83%	2,952,000	105%
	Seminoe	398,020	1,017,275	39%	483,140	85%
	Boysen	488,016	741,594	66%	485,068	101%
	Buffalo Bill	315,923	644,126	49%	374,462	84%

Figure RES-1. All reservoir content data is from the end of April 2011. Percent of average ranges are color coded

as follows: green: 80Ð100%; light green: 60Ð79%; yellow: 40Ð59%; orange: 20Ð39%; red: 0Ð19%.

In **Colorado**, above-average reservoir storage at the end of April was reported throughout the Colorado, Yampa, Gunnison and combined San Juan, Animas, Dolores and San Miguel basins. In comparison to last month, storage volume decreased slightly in the Gunnison, Colorado, and Arkansas basins this month as reservoir operators anticipate abundant inflows this spring. The Rio Grande Arkansas basins were reporting below-average storage. Statewide storage remains at 101% of average, and 91% of last year's storage volumes.

Storage at the end of April in 41 of **Utah**Õs key irrigation reservoirs is at 75% of capacity, 2% more than last year. The reservoir storage by basin: Bear, 47% of capacity; Weber, 65% of capacity; Provo, 93% of capacity; Uintah Basin, 83% of capacity; SE Utah, 53% of capacity; Sevier, 82% of capacity; SW Utah, 89% of capacity.

Reservoir storage varies widely across **Wyoming** basins, but is at 99% of average statewide. Reservoirs on the North Platte River are at 106% of average; in the northeast at 112% of average; in the Wind River Basin at 94% of average; on the Big Horn at 101% of average; Buffalo Bill Reservoir on the Shoshone is at 95% of average; and reservoirs on the Green River are at 106% of average.

[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

Since March 2011, negative (cold) anomalies in sea surface temperature have continued to weaken in the central and eastern Pacific, and NOAA Climate Prediction Center has announced that the current La Ni–a is transitioning to ENSO-neutral conditions (Figures EN-1 and EN-2).

The broader range of ENSO indicators (including winds and atmospheric pressure gradients) incorporated into the Multivariate ENSO Index (MEI) indicate that the La Ni–a remains somewhat stronger than the sea surface temperatures alone would suggest, but the MEI is also expected to indicate weakening in the next few months.

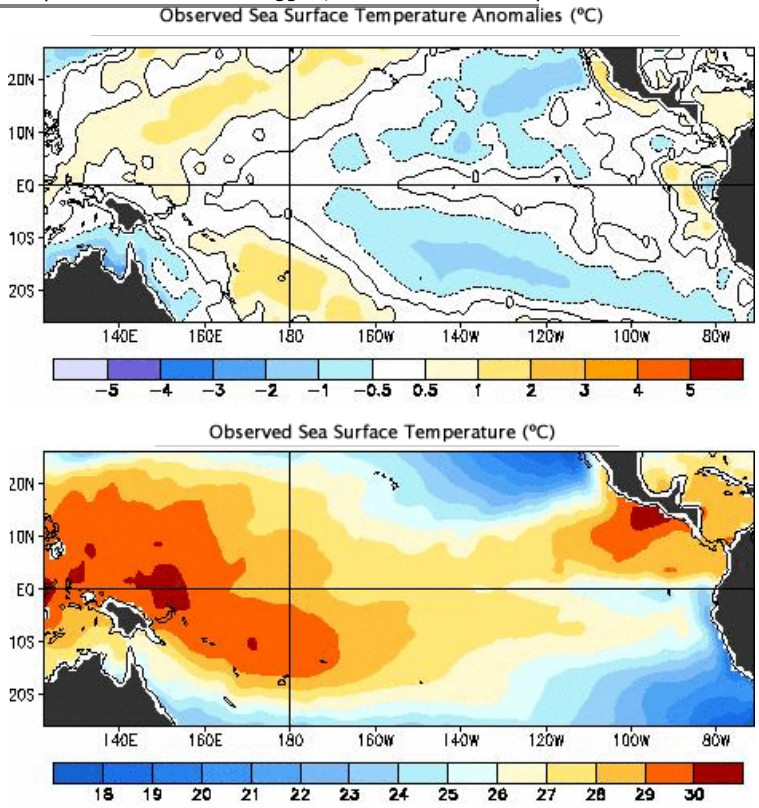

Figure EN-1. Observed SST anomalies (upper) and Observed SST (lower) in the Pacific Ocean. The Ni–o 3.4 region encompasses the area between 120iWÐ170iW and 5iNÐ5iS. The graphics represent the 7-day average centered on May 18, 2011. (Source: NOAA Climate Prediction Center)

Across a broad set of dynamical and statistical ENSO forecast models, nearly all models indicate ENSO-neutral

conditions by MayÐJuly 2011 (Figure EN-2), and several forecast the development of El Ni–o conditions by late fall. Several models, though, indicate a re-establishment of La Ni–a conditions in the fall, and this outcome would be consistent with the behavior of past La Ni–a events similar in strength to the current one.

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

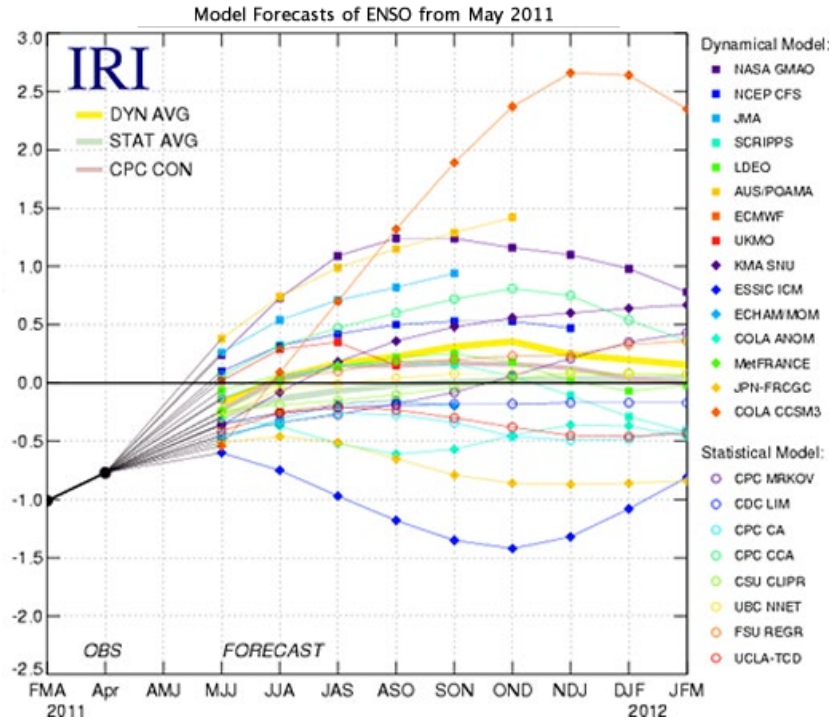

Figure EN-2. Forecasts made by dynamical and statistical models for sea surface temperatures (SST) in the Ni–o 3.4 region for nine overlapping 3-month periods from MayÐJuly 2011 to JanuaryÐMarch 2012 (released May 19, 2011). (Source: International Research Institute (IRI) for Climate and Society)

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Temperature Outlook
June–October 2011 (Released May 19, 2011)

The latest temperature outlooks from the NOAA Climate Prediction Center indicate an enhanced risk of warmer-than-average temperatures in southern **Utah** and **Colorado** for June, with the region of enhanced risk of warming spreading northward to cover much of the region in the JuneÐAugust and JulyÐSeptember seasons, and retreating somewhat for the AugustÐOctober season (Figures TEMP-1 through TEMP-4).

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 2011 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 16th.

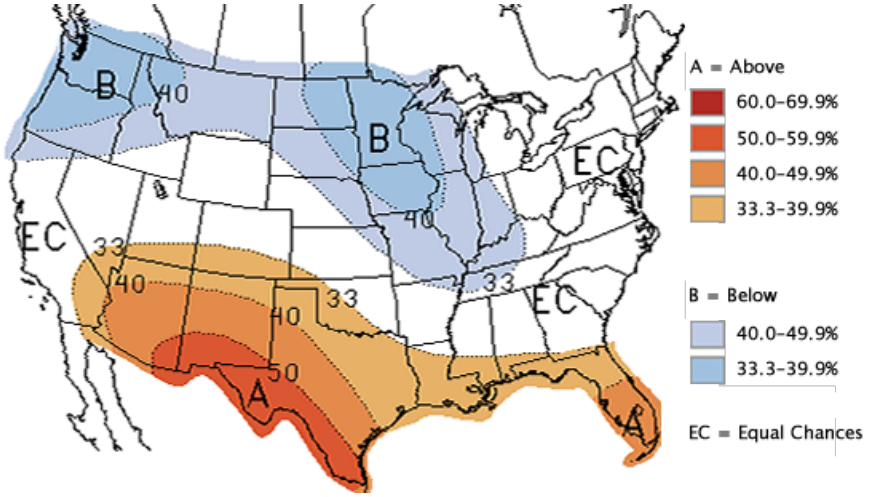

Figure TEMP-1. Long-lead national temperature forecast for June 2011. (Source: NOAA Climate Prediction Center)

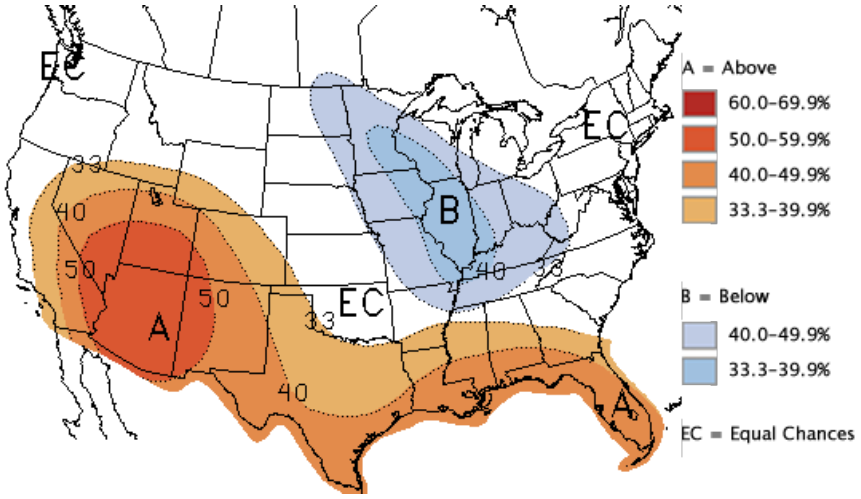

Figure TEMP-2. Long-lead national temperature forecast for JuneÐAugust 2011. (Source: NOAA Climate Prediction Center)

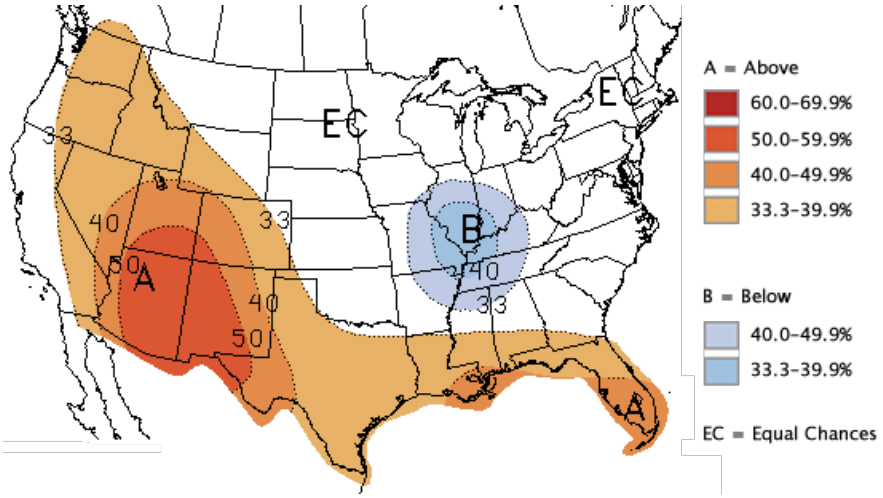

Figure TEMP-3. Long-lead national temperature forecast for JulyÐSeptember 2011. (Source: NOAA Climate Prediction Center)

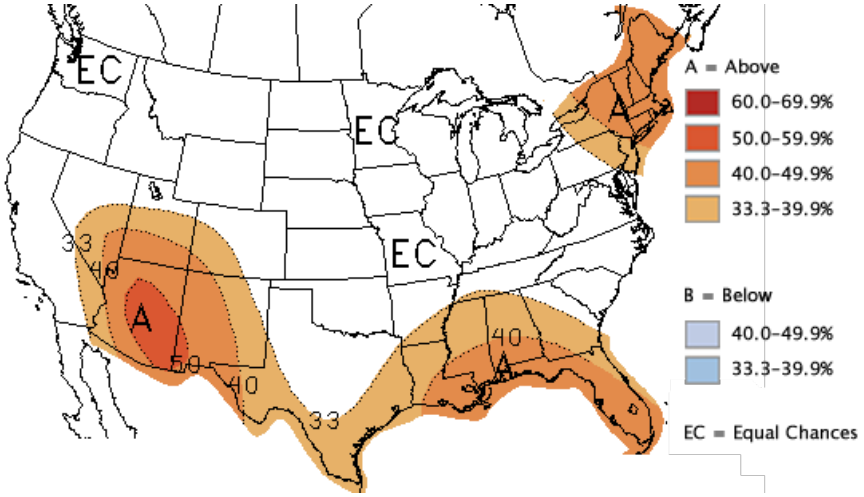

Figure TEMP-4. Long-lead national temperature forecast for AugustÐOctober 2011. (Source: NOAA Climate Prediction Center)

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Precipitation Outlook
June–October 2011 (Released May 19, 2011)

The NOAA CPC precipitation outlook for June (Figure PPT-1) shows equal chances (ÒECÓ) for above- and below-average precipitation across the region. For the JuneÐAugust and JulyÐSeptember seasons, an area of enhanced risk of drier-than-average conditions in the Northwest shifts to the south, covering parts of **Wyoming** (Figure PPT-2 and PPT-3). For the AugustÐOctober season, an area of enhanced chances of wetter conditions emerges in the central Great Plains, covering portions of eastern **Wyoming** and **Colorado** (Figure PPT-4).

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 2011 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 16th.

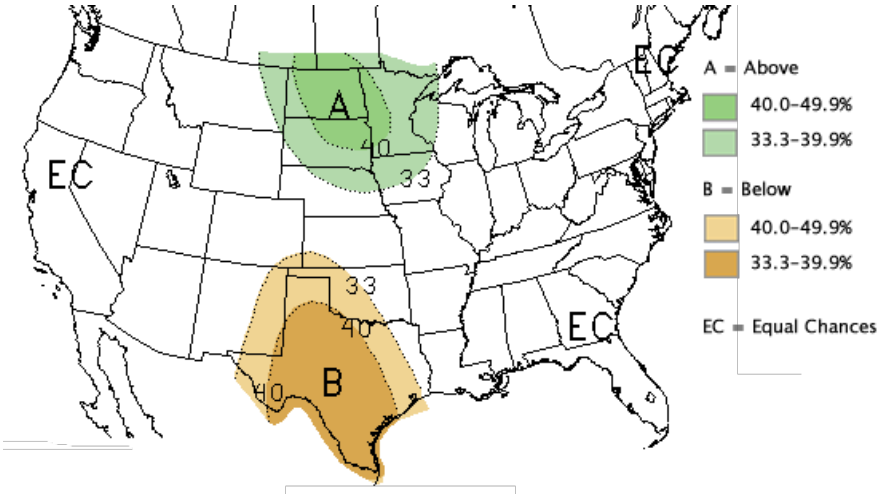

Figure PPT-1. Long-lead national precipitation forecast for June 2011. (Source: NOAA Climate Prediction Center)

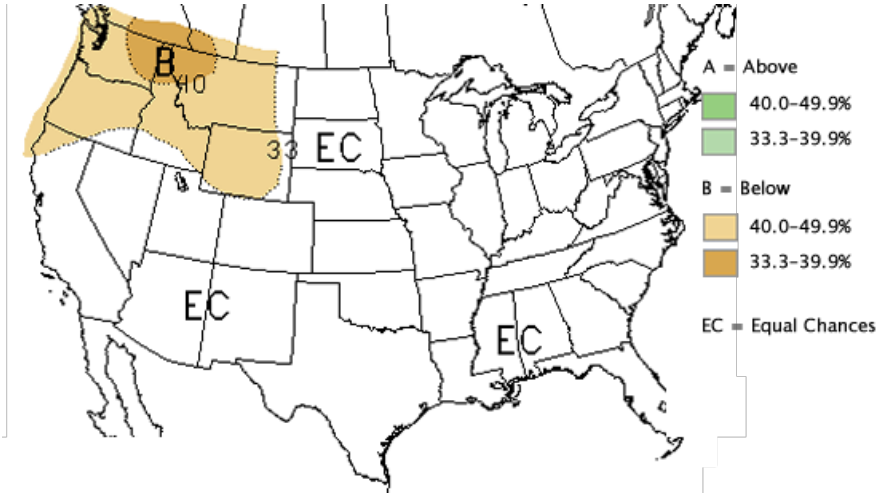

Figure PPT-2. Long-lead national precipitation forecast for JuneÐAugust 2011. (Source: NOAA Climate Prediction Center)

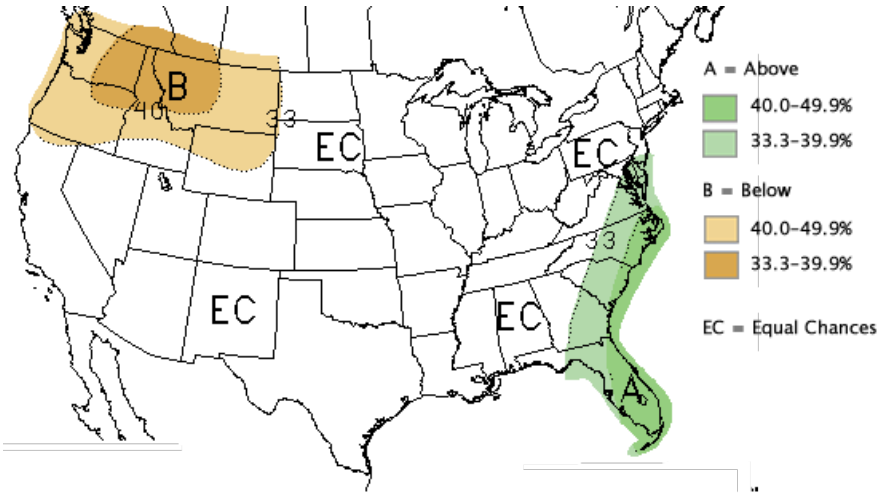

Figure PPT-3. Long-lead national precipitation forecast for JulyÐSeptember 2011. (Source: NOAA Climate Prediction Center)

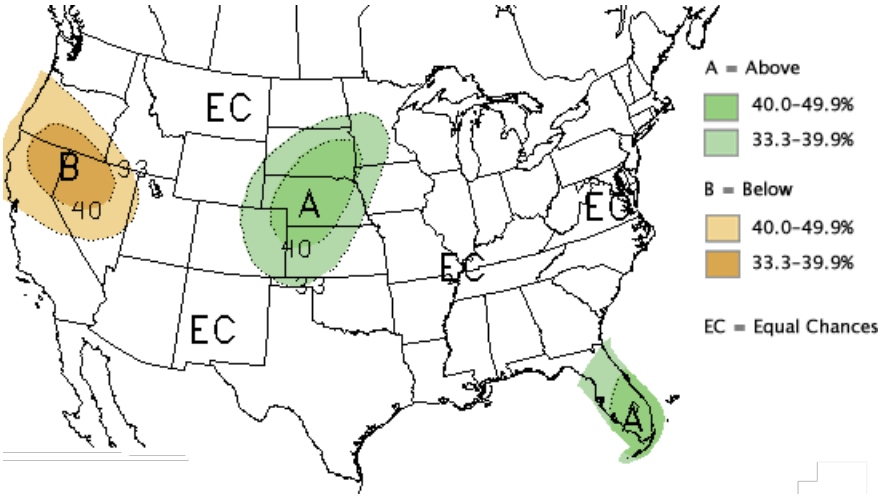

Figure PPT-4. Long-lead national precipitation forecast for AugustÐOctober 2011. (Source: NOAA Climate Prediction Center)

According to the experimental PSD Precipitation Forecast Guidance released in mid-April, there is a tilt towards dryness for the AprilÐJune period for the southern and eastern parts of **Colorado** and far southeastern **Utah**, with a tilt towards wetter-than-average conditions continuing over northwestern **Colorado** (Figure PPT-5a). Thus

far in the period (as of May 21) this guidance has largely verified, with very dry conditions over south-central and southeast **Colorado**, and wet conditions over northwestern **Colorado**. The preliminary forecast guidance for the summer (JulyÐSeptember; Figure PPT-5b) is highly uncertain given the lead time, but points to mostly near-average or even wet conditions over the four-state region covered by the forecast guidance.

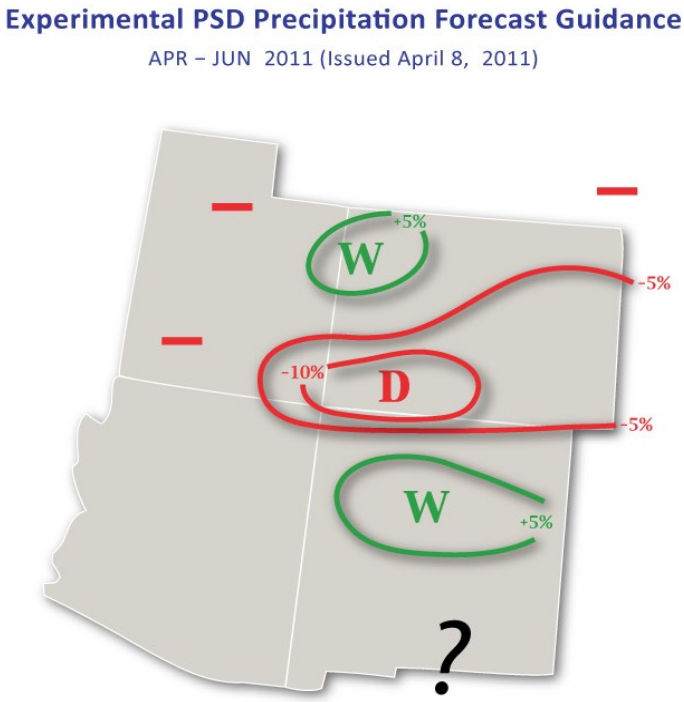

Figure PPT-5a. Experimental precipitation forecast guidance. Forecasted shifts in tercile probabilities for MayÐJune 2011. (Source: NOAA ESRL Physical Science Division)

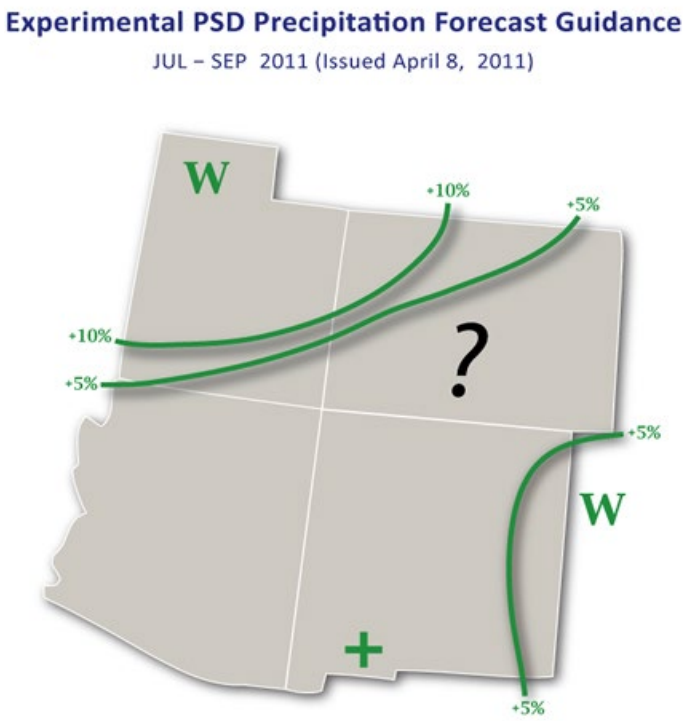

Figure PPT-5b. Experimental precipitation forecast guidance. Forecasted shifts in tercile probabilities for JulyÐ September 2011. (Source: NOAA ESRL Physical Science Division)

Notes & Weblinks

(provides explanations of graphics and additional information sources)

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Seasonal Drought Outlook
through August 2011 (Released May 19, 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**, currently experiencing severe (D2) and extreme (D3) drought conditions, is projected to see improvement in those conditions over the next three months (Figure DO-1). Drought conditions are not expected to develop elsewhere in the region.

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.

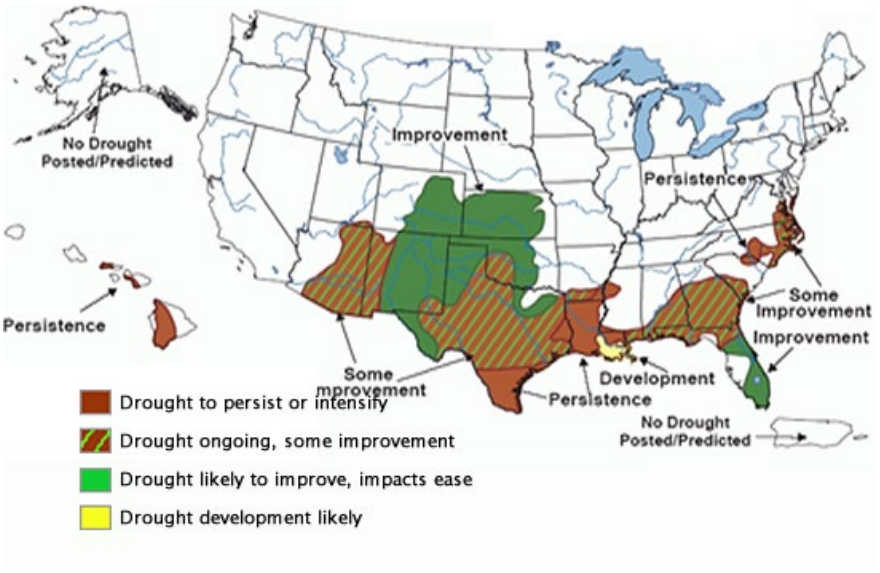

Figure DO-1. Seasonal Drought Outlook for May 19, 2011ÐAugust 2011. (Source: NOAA Climate Prediction Center)

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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