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INTERMOUNTAIN WEST CLIMATE SUMMARY

A product of the Western Water Assessment

Issued March 23, 2009, Vol. 5, Issue 2

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March 2009 Summary

Hydrological Conditions — *Drought persists in eastern Colorado, western and central Wyoming, and western Utah. Drought status has remained relatively constant through the region since the last IWCS in January.*

Temperature — *Monthly average temperatures for February 2009 were above average throughout most of the Intermountain West region, with anomalies up to 6Ð8¼F above average and several broken records for daily max and min temperatures. Only small pockets within each state experienced below average temperatures.*

Precipitation — *Precipitation in February 2008 was below average throughout most of the region, with the exception of eastern Colorado. This pattern of below average precipitation throughout the IMW may continue through March.*

ENSO — *Current sea surface temperatures and atmospheric conditions are consistent with a La Ni–a event. However, these conditions are expected to gradually weaken to ENSO-neutral conditions during the spring.*

Climate Forecasts — *There is an increased chance of above average temperatures throuhout the spring and summer, especially between May and August. The region has increased chances for below average precipitation as well, particularly from April through July.*

RETURN TO TOP

Announcements & News

We are completing the transition to the new IWCS and we welcome your feedback!

This month we transition to our web-based format. The entire IWCS can be accessed on this webpage. The notes and the Òon the webÓ links are located on a separate linked page that can be accessed on the navigation bar on the left, or at the bottom of each text section (below). The feature articles and focus pages will maintain the original IWCS layout and are not in web format. Rather, files but can be downloaded as pdfs. For ease of printing, click on the ÒPrinter-Friendly VersionÓ link at the top of this page to display a print-ready version of the IWCS. We will continue to archive pdfs of feature articles and focus pages, as well as previous issues of the IWCS on a separate web page, which is linked on the left-hand navigation bar.

In addition, we will be revising our publication timeline. Next month (April 2009) we will release a modified version of the IWCS that includes only the snowpack, streamflow, and drought monitor updates. Full IWCS publications will be issued in January, March, May, July, and October.

We appreciate your input, and please let us know what you think of these changes. Email: **wwasummary@wwa.colorado.edu**

NOAA Utah Meeting on Water Supply and Climate Change

NOAA organized a one day meeting on climate change and water supply for Utah at the Salt Lake City Library on February 24, 2009. About 100 people with various roles and interests in water resources attended the meeting. Participants included water managers, university researchers, state and local government officials, and non-profit advocacy groups.

The meeting included three sessions. The first session addressed the science behind climate change. Joe Barsugli (Western Water Assessment), Rob Gillies (Utah State Climatologist), Thomas Reichter (University of Utah), and Fred Wagner (Utah State University) each spoke on various aspects of climate science including models, projections, downscaling, and impacts of climate change. Andrea Ray (NOAA/ESRL) moderated a panel discussion following the talks. The second session included speakers from the Colorado Basin River Forecast Center speaking on the hydrologic modeling and seasonal forecasts for water supply and was facilitated by Brian McInerney. Speakers included Greg Smith, Brent Bernard, and Kevin Werner. The third session featured a panel of water managers with discussion on how they use or would like to use science to inform their decision making process. Panelists included Keith Denos (Provo River Water Users Association), Richard Bay (Jordan Valley Water Conservancy District), and Tage Flint (Weber Basin Conservancy District). The discussion was facilitated by John Daley (KSL Channel 5 Television). Preliminary feedback on the event has been very positive. Several people commented on the need for future meetings to update and/or expand on the science and policy associated with climate change.

The meeting was organized by three NOAA groups: the Colorado Basin River Forecast Center, the Salt Lake City Weather Forecast Office, and the Western Water Assessment. The principle organizers of the meeting were Kevin Werner (kevin.werner@noaa.gov) and Brian McInerney (brian.mcinerney@noaa.gov).

Presentations from the meeting are available here:
http://www.wrh.noaa.gov/slc/river/presentations/symposium.php

Feature Article

Preliminary Findings from Western Water AssessmentÕs ÒWater Rights and Climate Change ProjectÓ

By Doug Kenney (WWA), Roberta Klein (WWA), Christopher Goemans (Colorado State University)

(download pdf)

Focus Article

The Climate Prediction CenterÕs U.S. Temperature and Precipitation Trend Maps

By Julie Malmberg (WWA)

(download pdf)

Recent Climate Conditions

Both the SPI and Drought Monitor are used as drought indicators, but they are developed using different data. The SPI is solely a function of precipitation, while the Drought Monitor incorporates a broader scope of factors including precipitation, temperature, the Palmer Drought Severity Index, soil moisture, streamflow, vegetation stress, and socioeconomic impacts. The 3-month SPI reflects short-term precipitation patterns, and can therefore vary from month-to-month in response to changes in monthly average precipitation. Long-term precipitation trends are indicated by the 36-month SPI maps and the Drought Monitor, however the Drought Monitor is more sensitive to changes in monthly average precipitation than the 36-month SPI.

Average temperatures across the Intermountain West measured between 5 and 45¼F (Figure RC-1), translating to at or above average temperatures for February (Figure RC-2). Precipitation registered at or below average throughout the region (Figure RC-4), which is consistent with the 3-month SPI (Figure RC-5). The exception was the far eastern Plains of **Colorado** where precipitation totals, although less than 1 inch (Figure RC-3), were 120 to 200% of average.

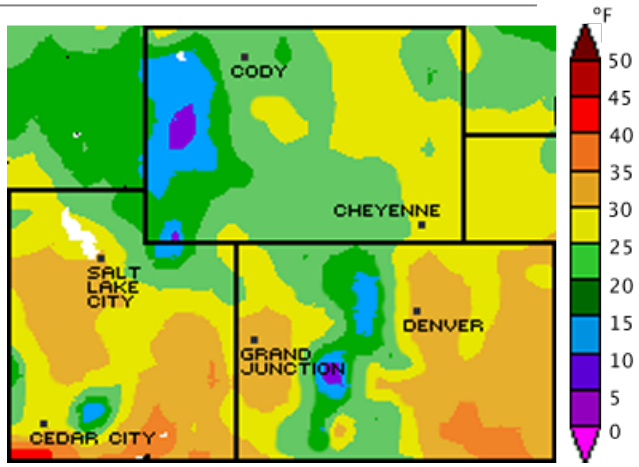

Figure RC-1. Average temperature for the month of February 2009 in iF. (Source: High Plains Regional Climate Center)

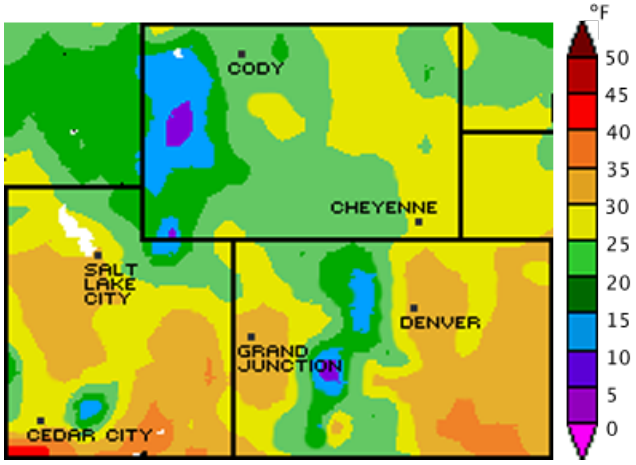

Figure RC-2. Departure from average temperature for the month of February 2009 in iF. (Source: High Plains Regional Climate Center)

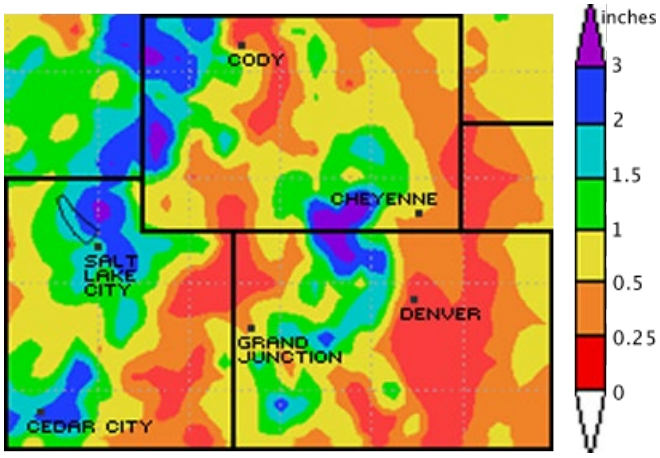

Figure RC-3. Average precipitation for the month of February 2009 (inches). (Source: NOAA ESRL Physical Science Division)

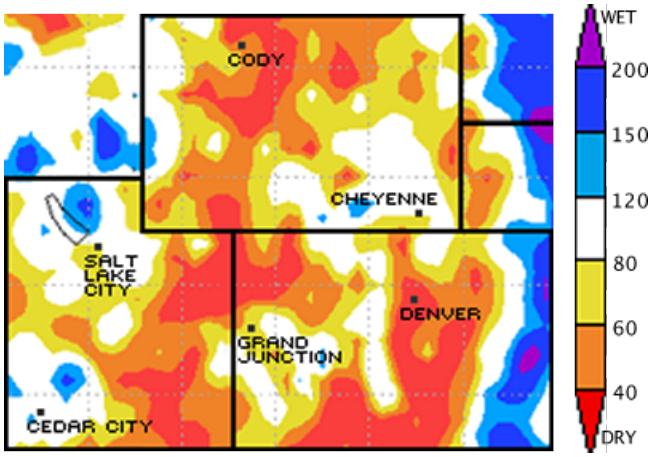

Figure RC-4. Percent of average precipitation for the month of February 2009. (Source: NOAA ESRL Physical Science Division)

Despite this relatively high precipitation as a percent of average in the east, the 3-month SPI shows all the climate divisions in **Colorado** as being in the near average category (-0.74 to +0.74). For **Utah** and **Wyoming**, average February precipitation (Figure RC-4) was largely consistent with the 3-month SPI map (Figure RC-5), reflecting an ongoing pattern of average to dry conditions. In parts of the Intermountain Wes, drying is also evident as a longer-term pattern in the 36-month SPI (Figure RC-6), where half of **Wyoming** and western **Utah** remain in the very dry category (-1.99 to -1.25). The only exception to this pattern is the Powder, Little Missouri and Tongue Drainage climate division in **Wyoming**, which is in the moderately wet category (+0.75 to +1.24).

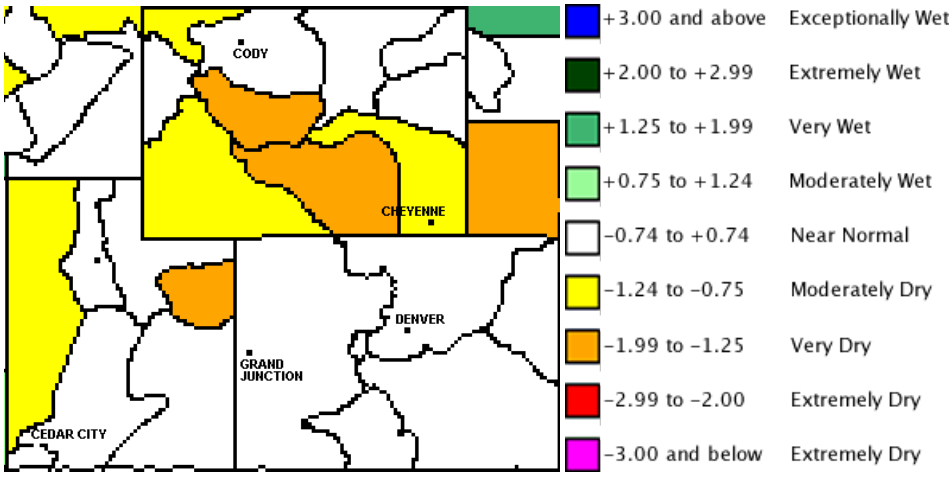

Figure RC-5. 3-month Intermountain West regional Standardized Precipitation Index from February 2009 (data from 12/01/08Ð 2/28/09). (Source: Western Regional Climate Center)

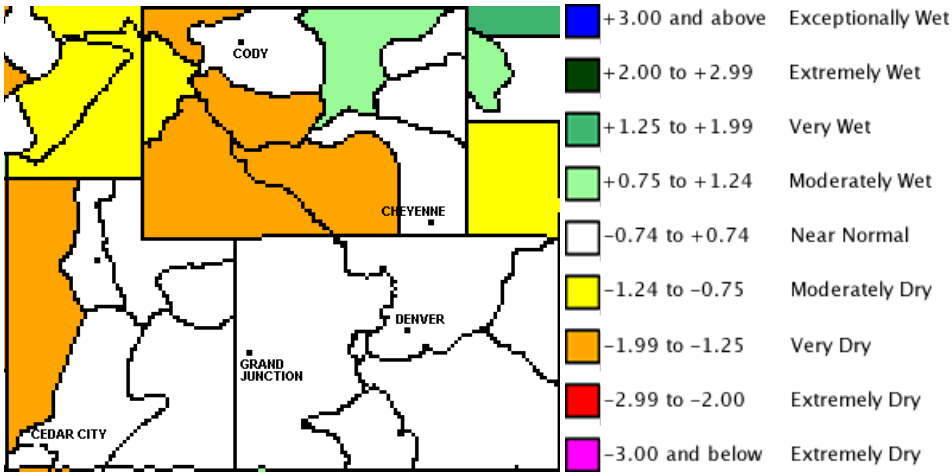

Figure RC-6. 36-month Intermountain West regional Standardized Precipitation Index from February 2009 (data from 03/01/07Ð2/28/08). (Source: Western Regional Climate Center)

The drought monitor (Figure RC-7) indicates D0 (abnormally dry) to D1 (moderate drought) conditions in all the climate divisions categorized as moderately dry to very dry in the 36-month SPI (Figure RC-6). Although not reflected in the precipitation-driven 36-month SPI, the eastern half of **Colorado** remains abnormally dry (D0). Persistent above average temperatures (Figure RC-2) and average to below average precipitation totals along the Front Range of the **Colorado** Rockies (Figure RC-4) produced an area of moderate drought (D1) from southwest of Denver northward to the **Wyoming** border (Figure RC-7). According to the drought monitor discussion, strong winds (more than 25 days with wind gusts exceeding 30 mph in Denver and Colorado Springs during the past three months) and the occurrence of record daily high temperatures contributed to the deteriorating drought conditions.

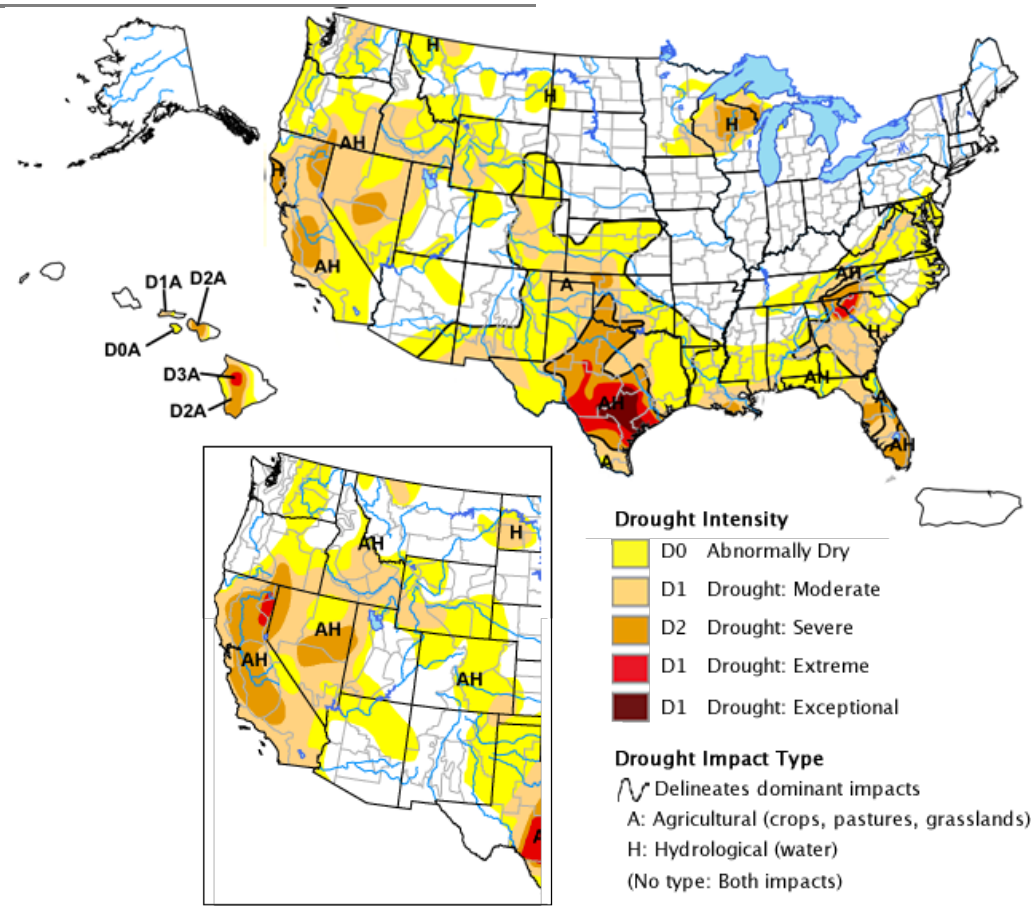

Figure RC-7. Drought Monitor from March 17, 2009 (full size) and January 5, 2009 (inset, lower left) for comparison. (Source: National Drought Mitigation Center)

Location	New Record		Old Record	
February 8				
Hanksville, UT	High Max T	62ºF	62ºF	1970
February 23				
Pueblo, CO	High Max T	75ºF	72ºF	2002, 1930
February 24				
	High			

Hanksville, UT	Max T	72ºF	70ºF	1981
Utah Test Range	High Max T	60ºF	60ºF	1995
Alpine, UT	High Min T	44ºF	42ºF	1986
Provo, UT	High Min T	43ºF	43ºF	1986
Utah Test Range	High Min T	35ºF	33ºF	1998

Table RC-1. Record temperature and precipitation events in the Intermountain West during February 2009. (Source: NOAA National Weather Service)

Intermountain West Snowpack

As of March 1, snowpack across the Intermountain West ranged from between 50Ð89% of average in central **Utah**, central **Wyoming,** and southwestern **Wyoming,** to between 90Ð129% of average across most of **Colorado**, southwestern **Utah**, and northern **Wyoming** (Figure SP-1). Precipitation in February as a percent of average varied across the region as well. **Colorado** saw generally warm and dry conditions. **Utah** had a lot of snowy days, but the amount accumulated at the higher elevations was not sufficient to increase the percent of average snowpack. **WyomingÕs** year-to-date precipitation is slightly above average for the year.

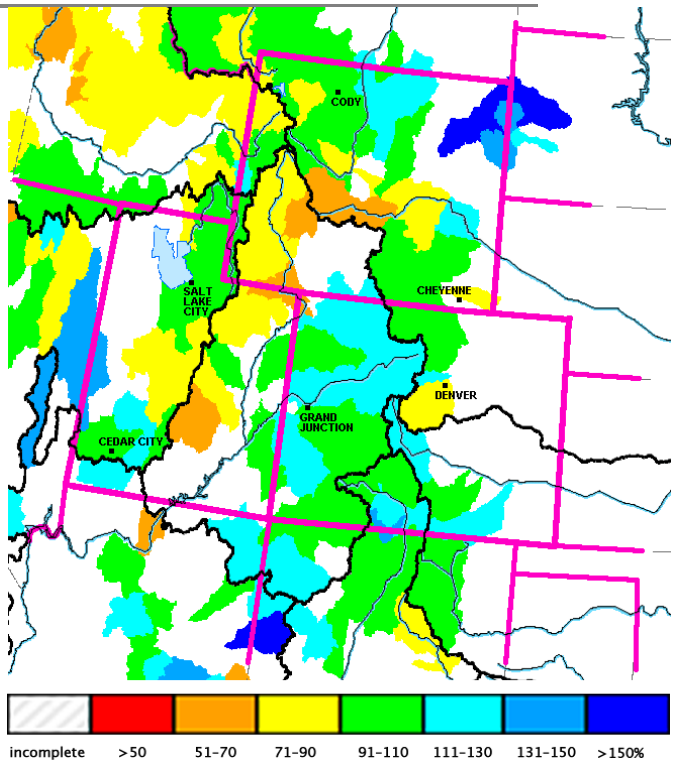

Figure SP-1. Snow water equivalent (SWE) as a percent of average for available SNOTEL and snow course sites in the Intermountain West as of March 1, 2009. (Source: Natural Resource Conservation Service)

As a result of a warm and dry February, **Colorado** snowpack percentages decreased in all major basins since

February 1 yet remain above average nearly statewide. Decreases in the snowpack percentages range from four percentage points in the Yampa, White, and North Platte River Basins, to as much as 16 percentage points in the Rio Grande River Basin. This is the second consecutive month of decreasing statewide snowpack percentages. At this point in the season, snowpack totals remain above average in all basins except the South Platte, which dipped to 94% of average. The highest snowpack percentages were measured in the Colorado Basin, at 115% of average. Without above average spring moisture, any portion of the state is at risk of below average snowpack totals by the average date of peak snowpack (April 1).

In **Utah**, the Weber and Sevier River Basins, and southwest **Utah** all received average snow accumulations in February, and the rest of the state received about 75% to 85% of average February accumulation. Snowpacks across **Utah** now range from 83% over the Uintas to 119% in the southwest. The pattern relatively more snow in the south, and less in the north and on the east side of the Wasatch and Sevier Plateaus, remains. March 1 snowpacks as measured by the NRCS SNOTEL system are as follows: Bear -90%, Weber -97%, Provo -94%, Uintas -83%, southeast Utah -85%, Sevier -100%, southwest Utah -119%. A very large March snow accumulation (110Ð180%) is necessary over most areas except southern **Utah** to reach an average snowpack by April 1.

Most basins in **Wyoming** have near or above average snowpacks as of March 1. SWE in the NW portion of Wyoming is about 90% of average. NE **Wyoming** SWE is about 120% of average. The SE **Wyoming** SWE is about 103% of average. The SW **Wyoming** SWE is about 93% of average. Snowpacks are lower in the Upper North Platte and Green River Basins (between 50Ð89% of average).

[This text comes largely from the NRCS State Basin Outlook Reports].

Spring and Summer Streamflow Forecasts for the 2009 Runoff Season

Spring and summer streamflow forecasts remain near or above average for most of **Colorado** and eastern **Wyoming**, but below average for the rest of the Intermountain West Region (Figure STRM-1). Since February, streamflow forecasts decreased across most of **Wyoming** and southern **Colorado**. The rest of the region stayed the same.

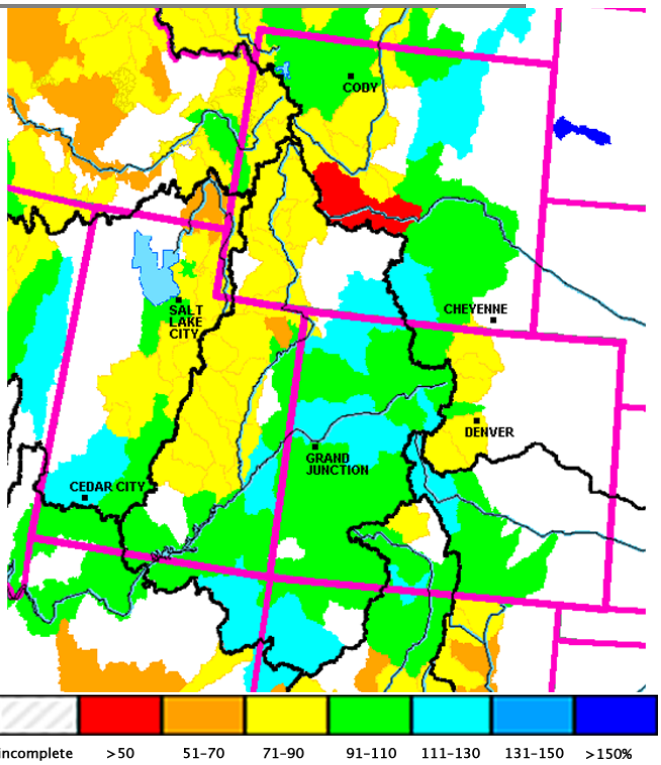

Figure STRM-1. NRCS outlook for natural streamflows for spring and summer in the Intermountain West region as a percent of average streamflows (data through March 1, 2009). (Source: Natural Resource Conservation Service)

If March weather continues the pattern established in February, **Colorado's** snowpack will be below average by April 1. While most basins can continue to expect near average to slightly above average runoff this spring and summer, the decreases reflect significant declines from the forecasts issued back in January. At this point, the best prospects for good runoff are confined to northwestern **Colorado**, where slightly above average runoff (105Ð115% of average) is forecast in much of the Colorado and Yampa River Basins. East of the Continental

Divide, volumes are mostly below average, with the lowest forecasts concentrated in the South Platte River Basin. Volumes of less than 85% of average are now forecast at many locations in the South Platte River Basin.

General water supply conditions are near average in northern **Utah**, except for the Bear River Basin. Streamflow forecasts are above average on the Virgin and Beaver River Basins and near to below average in central **Utah**. Streamflow forecasts range from 57% for the Duchesne River near Randlett to 124% of average on Coal Creek near Cedar City. Most flows are forecast to be in the below to near average range.

Streamflow yield is expected to be slightly below average across **Wyoming**. Streamflow forecasts range from 71 and 75% of average in the Green River and Wind River Basins, respectively, to 182% of average in the Belle Fourche & Cheyenne River Basins.

[This text comes largely from the NRCS State Basin Outlook Reports].

Reservoir Supply

There is no reservoir supply article this month.

El Niño Status and Forecast

According to according to the NOAA Climate Prediction Center and its partner the International Research Institute for Climate and Society (IRI), current sea surface temperatures (SSTs) and atmospheric conditions are consistent with a La Ni–a event (Figure EN-1). However, these conditions are expected to gradually weaken to ENSO-neutral conditions during the northern hemisphere spring.

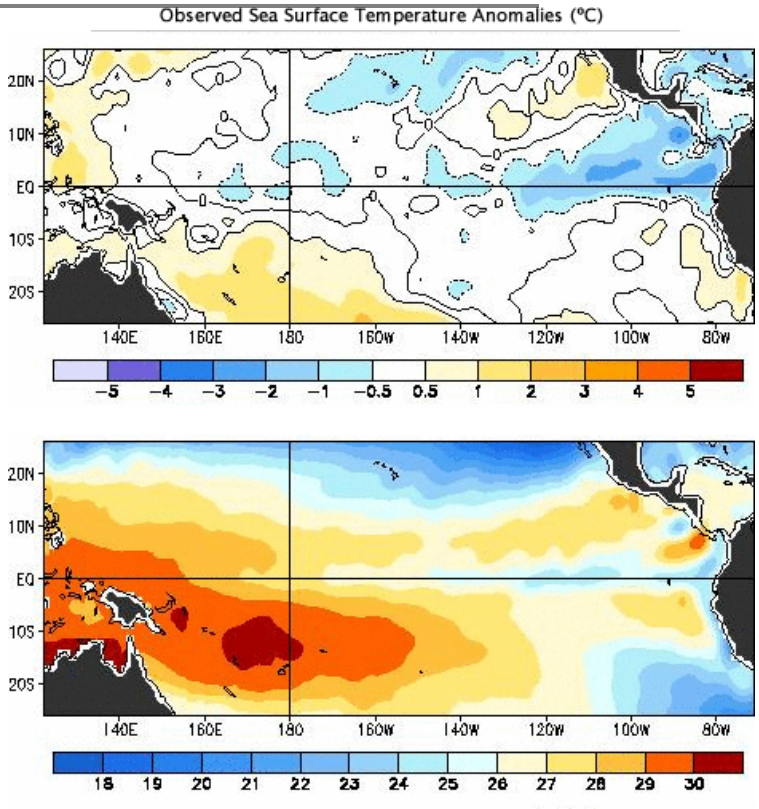

Figure EN-1. Observed SST (upper) and the observed SST anomalies (lower) in the Pacific Ocean. The Ni–o 3.4 region encompasses the area between 120iWÐ170iW and 5iNÐ5iS. The graphics represent the 7-day average centered on November 12, 2008. (Source: NOAA Climate Prediction Center)

Nearly all the dynamical and statistical model forecasts for the Ni–o-3.4 region show that La Ni–a will have dissipated by MayÐJuly 2009 (Figure EN-2), although the exact timing of the transition to ENSO-neutral conditions is uncertain. Based on model forecasts and current observations of the ocean surface and subsurface, there is an estimated 50% probability of La Ni–a conditions persisting during the MarchÐMay season in progress, with the probability of neutral conditions 45Ð50%, and near-zero chance for El Ni–o conditions. For the MayÐJuly 2009 season, the estimated probability of La Ni–a conditions decreases to 25Ð30%, as ENSO-neutral conditions become most likely. Beginning in JuneÐAugust, no tilt away from the climatological odds of 25-50-25% (La Ni–a-neutral-El Ni–o) is indicated in the forecasts.

Compared to the Northern Hemisphere winter, La Ni–a impacts over the U.S. are typically less pronounced during spring. Potential impacts include below-average precipitation across the southern states, below-average temperatures in the Pacific Northwest and above-average temperatures across much of the southwestern and south-central United States. The NOAA ENSO Diagnostic Discussion will be updated on the second Thursday of April 2009.

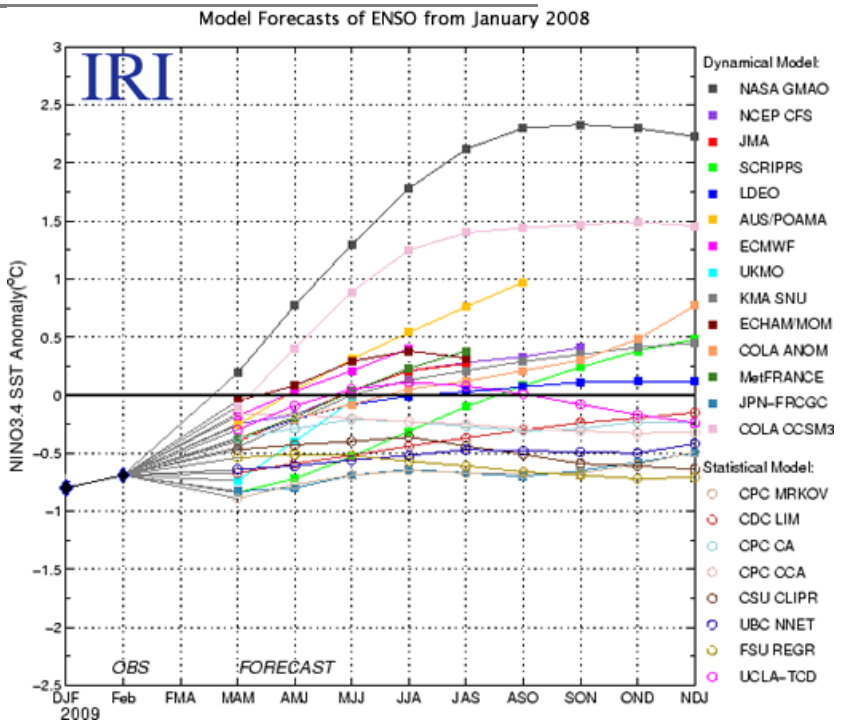

Figure EN-2. Forecasts made by dynamical and statistical models for sea surface temperatures (SST) in the Ni–o 3.4 region for nine overlapping 3-month periods from February 2009ÐJanuary 2010 (released March 19, 2009). (Source: International Research Institute (IRI) for Climate and Society)

Temperature Outlook
April–August 2009 (Released March 19, 2009)

The latest temperature outlooks for April 2009 and following seasons from the NOAA Climate Prediction Center indicate an enhanced risk of above average temperatures in all or parts of **Utah** and **Colorado** (Figures TEMP-1, 2). The area of enhanced risk of above average temperatures extends into **Wyoming** in the MayÐJuly and JuneÐ August 2009 seasons (Figures TEMP-3, 4). The April 2009 forecast considers La Ni–a composites and positive temperature trends in the last several decades, as well as model output. The ongoing La Ni–a along with all of the statistical forecast support warmer temperatures for parts of the southwest.

The April 2009 temperature forecast will be updated on March 31st on the CPC web page. Because of the shorter lead-time, the Òzero-leadÓ forecast (i.e. on the last day of the previous month) often has increased skill over the half-month lead forecasts shown here. The Seasonal Outlooks are updated on the third Thursday of the month, and the next one will be issued on April 16th.

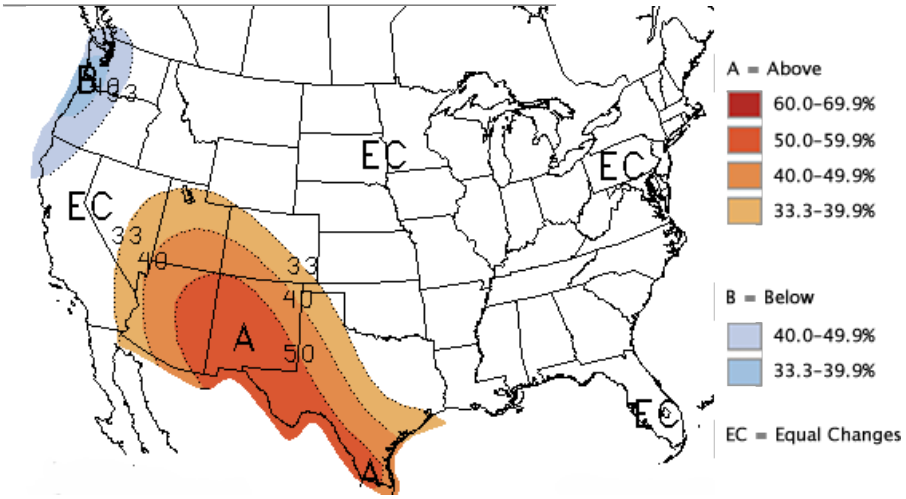

Figure TEMP-1. Long-lead national temperature forecast for April 2009. (Source: NOAA Climate Prediction Center)

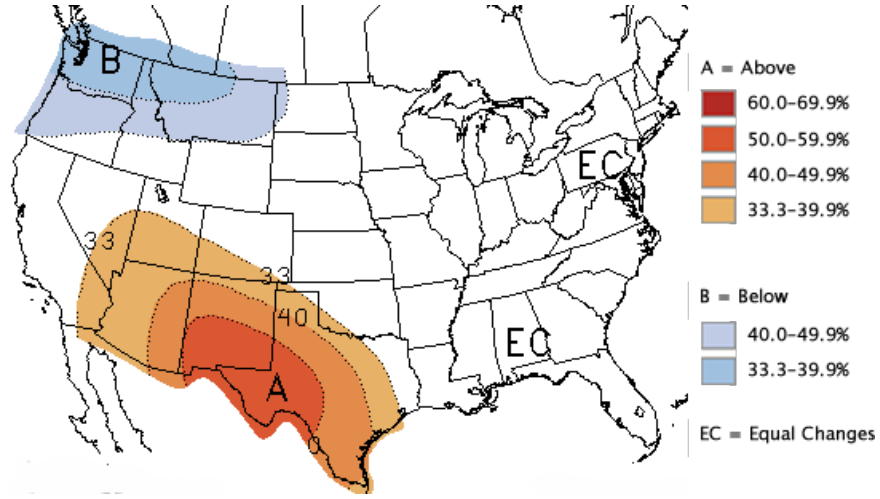

Figure TEMP-2. Long-lead national temperature forecast for AprilÐJune 2009. (Source: NOAA Climate Prediction Center)

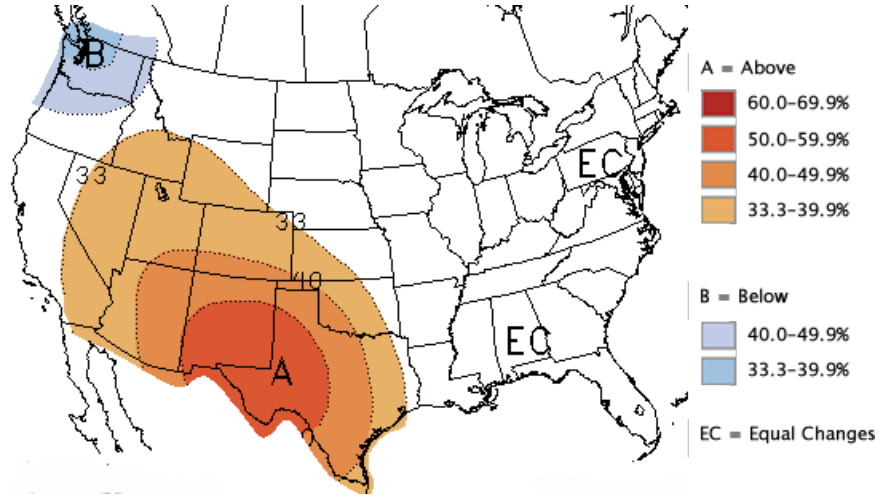

Figure TEMP-3. Long-lead national temperature forecast for MayÐJuly 2009. (Source: NOAA Climate Prediction Center)

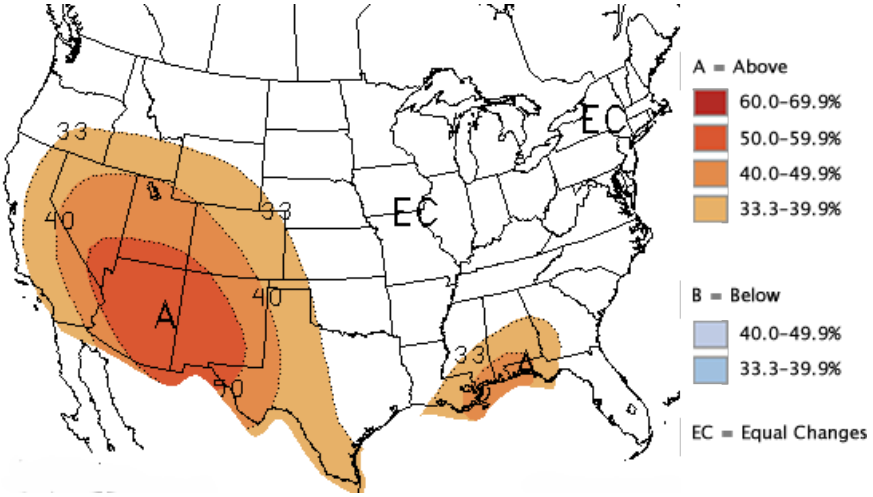

Figure TEMP-4. Long-lead national temperature forecast for JuneÐAugust 2009. (Source: NOAA Climate Prediction Center)

Precipitation Outlook
April–August 2009 (Released on March 19, 2009)

The CPC precipitation outlook for April 2009 shows below-median precipitation for a region including southwestern **Utah** and southern **Colorado**, extending across the southern tier of the U.S. (Figure PPT-1). The primary drivers for this outlook are typical La Ni–a conditions, recent trends and numerical climate model output. For the AprilÐ June and following seasons (Figures PPT-2, 3, 4), the area forecasted for increased chances for above-average temperatures includes all of **Utah** and **Colorado**, and most or all of Wyoming. This outlook is indicated by most statistical and dynamical forecast tools through the JuneÐAugust season.

The April 2009 precipitation forecast will be updated on March 31st on the CPC web page. Because of the shorter lead-time, the Òzero-leadÓ forecast (i.e. on the last day of the previous month) often has increased skill over the half-month lead forecasts shown here. The Seasonal Outlooks are updated on the third Thursday of the month, and the next one will be issued on April 16th.

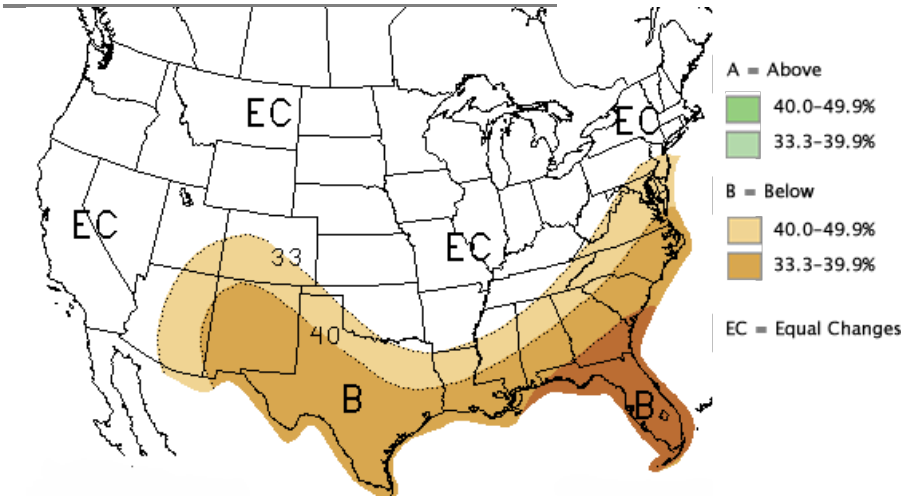

Figure PPT-1. Long-lead national precipitation forecast for April 2009. (Source: NOAA Climate Prediction Center)

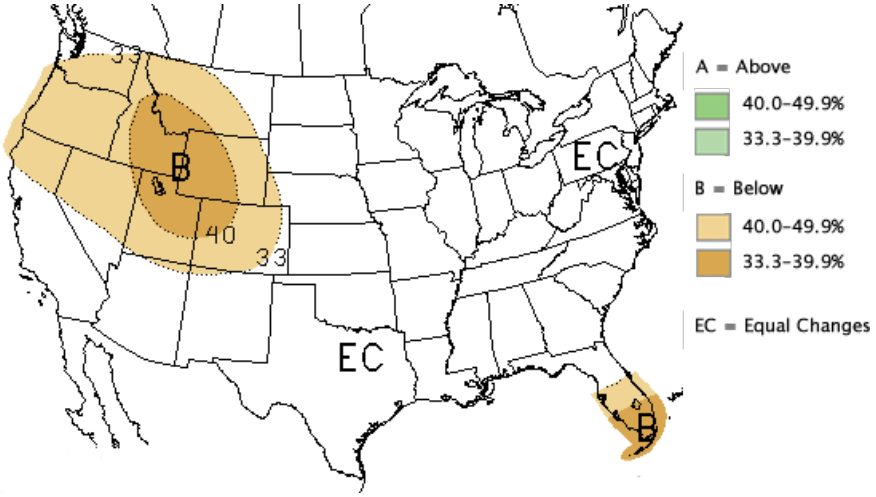

Figure PPT-2. Long-lead national precipitation forecast for AprilÐJune 2009. (Source: NOAA Climate Prediction Center)

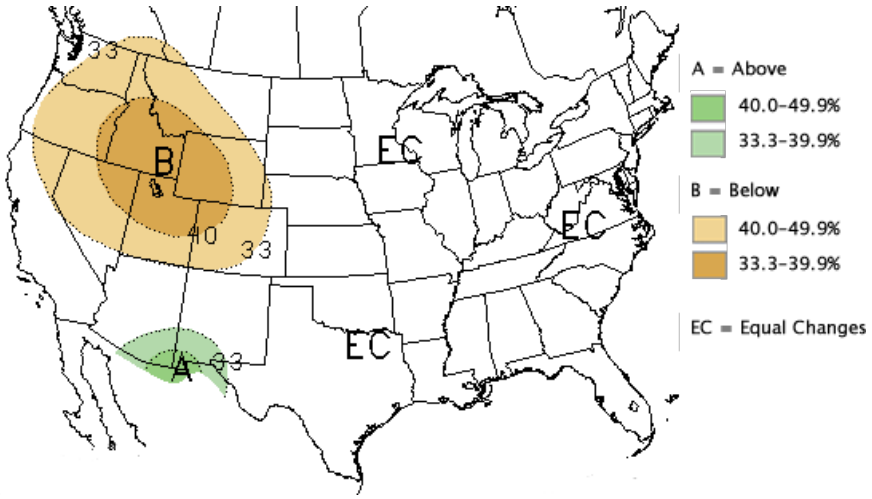

Figure PPT-3. Long-lead national precipitation forecast for MayÐJuly 2009. (Source: NOAA Climate Prediction Center)

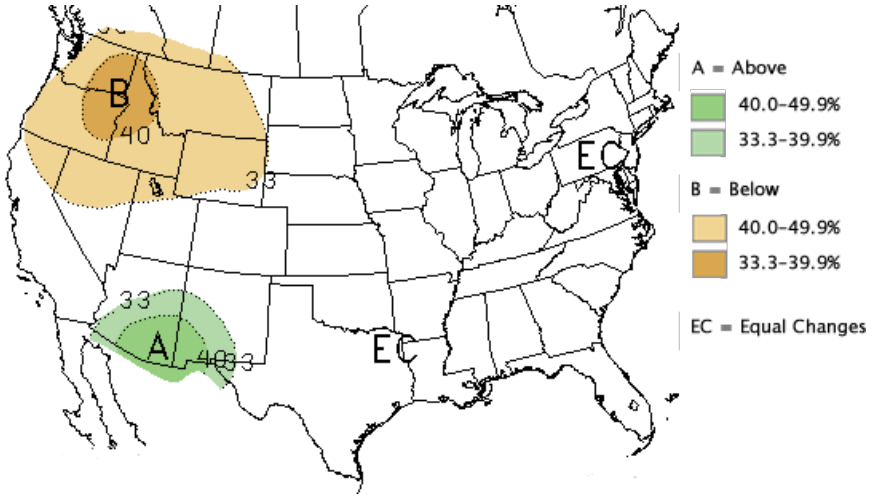

Figure PPT-4. Long-lead national precipitation forecast for JuneÐAugust 2009. (Source: NOAA Climate Prediction Center)

According to the experimental SWcast discussion issued March 19th, after a mostly dry fall (SeptemberÐ November), winter has brought above-normal moisture to the mountains of the interior southwestern U.S., raising for instance **Colorado's** statewide snowpack above the long-term average from late December through mid-March. However, this active stormtrack 'lost steam' over the last few weeks, so that statewide snowpack values have now dropped below the long-term mean. The next two weeks promise a return to somewhat cooler and

wetter weather going into April, giving the region at least a chance of still reaching near-normal peak snowpack values before the season winds down.

The SWCast experimental forecast guidance for April-June (Figure PPT-5) reflects both lingering La Ni–a impacts (a dry forecast from northern **Utah** into northern **Colorado**), as well as the possibility of a return to near-normal ENSO conditions which would allow for a wetter-than-average season from Arizona to northeastern New Mexico and northward into southeastern **Colorado**. The guidance indicates an increased chance of upper tercile precipitation in eastern **Colorado**, and increased chances of dry conditions in northern **Colorado** and northern **Utah**.

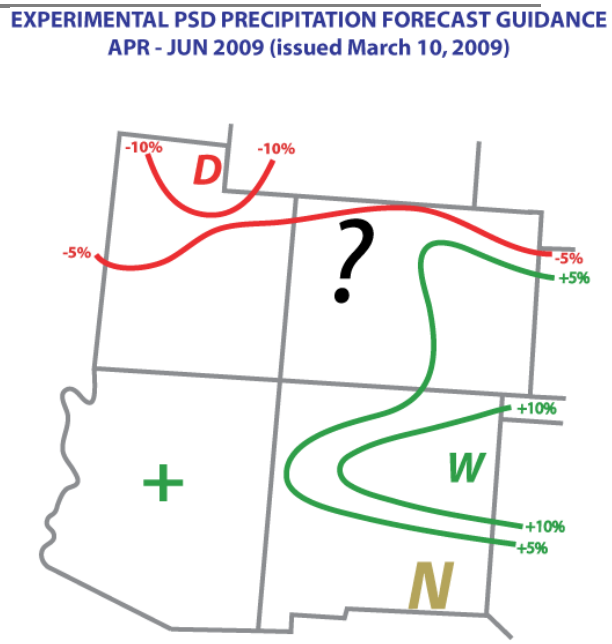

Figure PPT-5. Experimental precipitation forecast guidance. Forecasted shifts in tercile probabilities for AprilÐJune 2009. (Source: NOAA ESRL Physical Science Division)

Seasonal Drought Outlook
through June 2009 (Released March 19)

The DO issued March 19th, projects that drought is likely to persist in the Front Range and southeastern **Colorado** over the next three months (Figure DO-1). Drought is also likely to persist in southwestern **Wyoming** and western **Utah** because the wet season in these areas is winding down, making additional drought relief more difficult. This projection of improvement indicates at least a one-category change in drought status.

According to the U.S. Drought Monitor, ColoradoÕs Front Range has experienced worsening dry conditions. The U.S. Seasonal Drought Outlook (DO) says that the forecast for persisting drought for **Colorado** is consistent with La Ni–a soil moisture composites, the June Constructed Analogue Soil moisture forecast, and the April long-lead outlook for temperature and rainfall. The 2-week soil model forecast indicates drying in Colorado and western Kansas, as does the Climate Forecast system soil moisture change for June (See the July 2007 IWCS Feature Article on CPC Soil Moisture Products). There is considerable uncertainty about the location for improvement in the drought region given the range of possible weather developments into June: forecast confidence for the central Plains is low. There are no new areas of drought development elsewhere in the Interior West indicated in this DO. The next Seasonal Drought Outlook will be issued April 2nd.

Readers interested in the next 5 and 6-10 days can consult the ÒLooking AheadÓ section of each weekÕs DM for near-term drought outlook conditions. The U.S. Seasonal Drought Outlook (DO) builds on the DM categories to project how these drought areas might change or where new drought areas might develop.

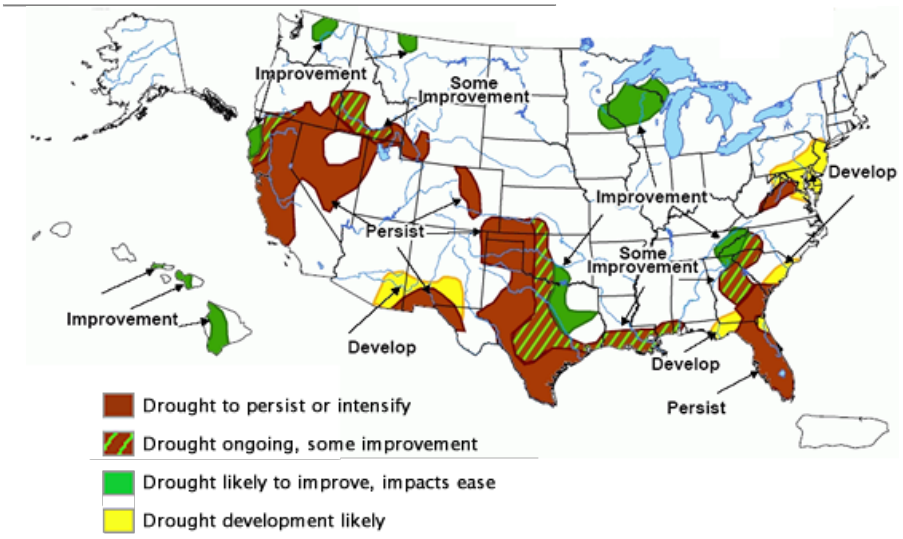

Figure DO-1. Seasonal Drought Outlook for March 19, 2009ÐJune 2009. (Source: NOAA Climate Prediction Center)

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