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INTERMOUNTAIN WEST CLIMATE SUMMARY

A product of the Western Water Assessment

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October 2009 Summary

Hydrological Conditions— *Since July, dry conditions have been alleviated in eastern Colorado but have emerged in far southern Utah and southwestern Colorado, with some areas of moderate (D1) and severe (D2) drought.*

Temperature & Precipitation— *Temperature anomalies across the region during September largely reflected the precipitation anomalies, with warmer-than-average temperatures in all areas other than the eastern slope of Colorado. Most of the region was drier than average in September, with only eastern Colorado receiving above-average precipitation.*

ENSO— *The El Ni–o event which began in July has recently strengthened and is now in the ÒmoderateÓ category. El Ni–o conditions are forecasted to persist through the winter.*

Climate Forecasts— *Seasonal outlooks indicate enhanced risk of above-average temperatures across much of the West in November 2009 and through the winter; the Intermountain West region is forecast to have "equal chances" of high or low precipitation over those periods.*

Announcements & News

"Dealing with Drought" Workshops

The WWA, in conjunction with the Colorado Water Conservation Board (CWCB), presented the ÒDealing with Drought-Adapting to a Changing ClimateÓ workshop series during October in three locations around Colorado: Castle Rock, Glenwood Springs, and Durango. These workshops built on themes and information from the October 2008 Colorado GovernorÕs Conference on Managing Drought and Climate Risk. The 80 participants represented diverse sectors and interests affected by drought and climate, including water resource management, agriculture, land-use planning, forest and range management, watershed protection, environmental organizations, and tourism & recreation.

Participants engaged with Colorado climate scientists Joe Barsugli, Jeff Lukas, Kristen Averyt, and Imtiaz Rangwala (WWA) and Nolan Doesken (CSU-Colorado Climate Center) in instructional sessions to learn more about ColoradoÕs climate and climate variability, the history of past drought in Colorado, scenarios for future climate change, and implications of climate change for water and other resources. During small-group discussion sessions, participants discussed the impacts of the 2000s drought, and what information or resources would help adapt to future droughts; and what potential impacts from a changing (warming) climate most concerned them. Discussion sessions were facilitated by those named above and by Christina Alvord (WWA), Taryn Hutchins-Cabibi (CWCB),

and Koren Nydick (Mountain Studies Institute). Input from these discussion sessions will be incorporated into the revised Colorado State Drought Plan scheduled for release in fall of 2010, and the Colorado Climate Action Plan. Participant surveys prior to and after the workshops assessed their climate literacy and use of climate information.

Workshop information including agenda, presentations, and discussion summaries will be posted in coming weeks on the workshop website, http://wwa.colorado.edu/drought09.php. This series of workshops was sponsored by the WWA, CWCB, and the National Integrated Drought Information System (NIDIS), along with the CSU Colorado Climate Center and the Mountain Studies Institute.

Changes in WWA and IWCS staff

Christina Alvord, who previously worked as a research associate with WWA from 2006Ð2008, returned to WWA in August as a research associate and will again serve as a writer and editor with the IWCS.

Feature Article

The Water Year 2009 in Review

By Christina Alvord (Western Water Assessment)

Focus Article

TreeFlow: A comprehensive web resource for tree-ring reconstructions of streamflow

By Jeff Lukas (Western Water Assessment)

Recent Climate Conditions

Temperatures throughout most of the Intermountain West were high relative to average conditions, ranging between 2¼F below average in the north to 8¼F above average in the southwest for the month of September (Figure RC-1, RC-2). Above-average temperatures occurred across northern **Wyoming**, transitioning to average temperatures in **Utah** and northwestern **Colorado**, which then trended toward below average temperatures in eastern **Colorado** (Figure RC-2). The average temperature for September exceeded 75¼F in the far reaches of southwest **Utah**, and typically ranged between 55¼F and 70¼F in the rest of the state. Average temperatures were relatively cooler in **Wyoming** and **Colorado**, (50¼F to 65¼F), with the coolest temperatures occurring at high elevation in the Rockies (Figure RC-1).

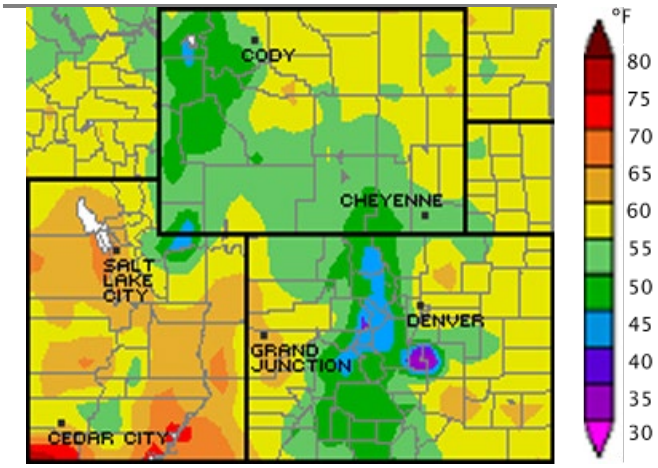

Figure RC-1. Average temperature for the month of September 2009 in iF. (Source: High Plains Regional Climate Center)

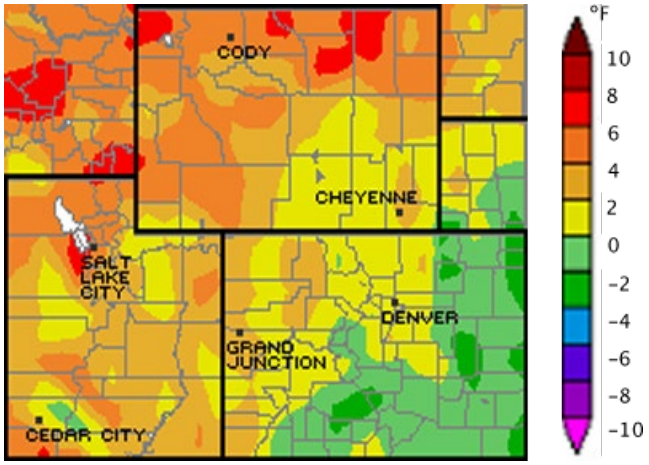

Figure RC-2. Departure from average temperature for the month of September 2009 in iF. (Source: High Plains Regional Climate Center)

Location	Record	New	Old	Year
September 6				
Bountiful Val Verda, UT	High Min Temperature	71ºF	66ºF	1998
Salt Lake City Airport, UT	High Min Temperature	70ºF	69ºF	2003
September 14				
Alamosa, CO	Daily Max Rainfall	0.36 inch	0.25 inch	1949
September 15				
Laramie Airport, WY	Daily Max Rainfall	0.49 inch	0.30 inch	1950
September 22				
Grand Junction Airport, CO	Low Min Temperature	34ºF	34ºF	1995
September 25				
Cedar City Airport, UT	High Max Temperature	86ºF	86ºF	1994
September 26				
Cedar City Airport, UT	High Max Temperature	88ºF	87ºF	1994
Tooele, UT	High Max Temperature	86ºF	86ºF	1922
Wendover, UT	High Max Temperature	90ºF	88ºF	1928
September 27				
Bryce Canyon Airport, UT	High Max Temperature	81ºF	80ºF	1963
Capitol Reef NP, UT	High Max Temperature	88ºF	86ºF	2001
Cedar City Airport, UT	High Max Temperature	88ºF	87ºF	2003
Escalante, UT	High Max Temperature	92ºF	91ºF	2003
Ferron, UT	High Max Temperature	88ºF	88ºF	2003
Hanksville, UT	High Max Temperature	95ºF	94ºF	2003
Lander, WY	High Max Temperature	87ºF	86ºF	1899

Worland, WY	High Max Temperature	89ºF	88ºF	2001
Randolph, UT	High Max Temperature	77ºF	77ºF	2003
September 29				
Casper, WY	High Max Temperature	86ºF	85ºF	1957, 1992
Salt Lake City Airport, UT	High Min Temperature	68ºF	60ºF	2001

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

Wyoming, **Utah**, and the western slope of **Colorado** received less than 75% of average precipitation for September (Figure RC-4). The lack of precipitation and elevated temperatures were sufficient to cause a shift toward drier conditions in the 3-month SPI for these climate divisions (Figure RC-5). However, the 36-month SPI (Figure RC-6) suggests that the above average precipitation that occurred across this region earlier in the summer was sufficient enough to minimize drying in the region (Figure RC-7). In eastern **Colorado**, where precipitation was generally >100% of average in September (Figure RC-3), both the 3-month and 36-month SPI indicate near average conditions (Figure RC-6).

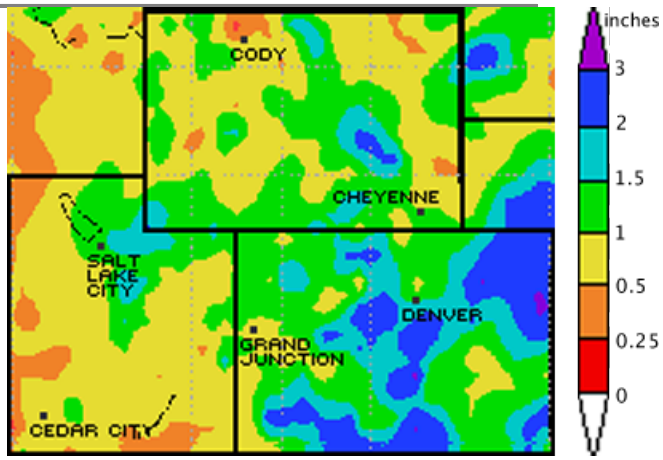

Figure RC-3. Precipitation for the month of September 2009 (inches). (Source: NOAA ESRL Physical Science Division)

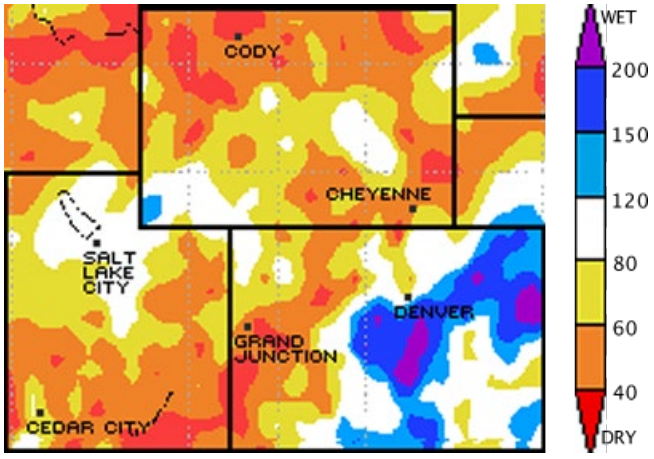

Figure RC-4. Precipitation for the month of September 2009 as percent of average precipitation for September. (Source: NOAA ESRL Physical Science Division)

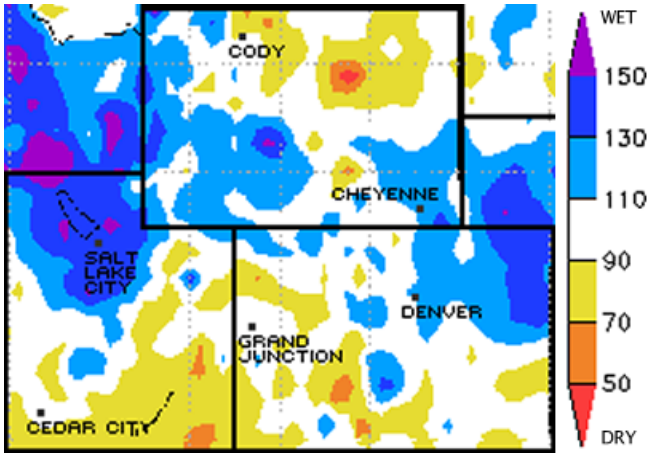

Figure RC-4b. Precipitation for the 2009 water year (October 2008ÐSeptember 2009) as percent of average precipitation for that period. (Source: NOAA ESRL Physical Science Division)

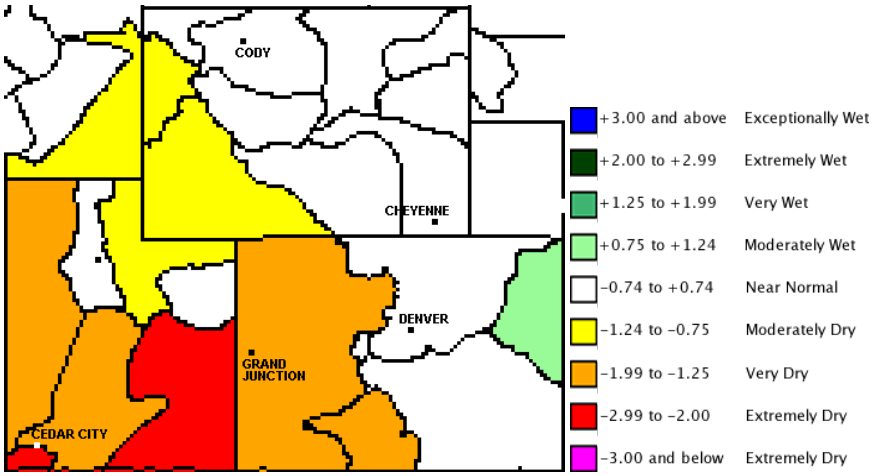

Figure RC-5. 3-month Intermountain West regional Standardized Precipitation Index as of the end of September 2009 (data from 7/01/09Ð 9/30/09). (Source: Western Regional Climate Center)

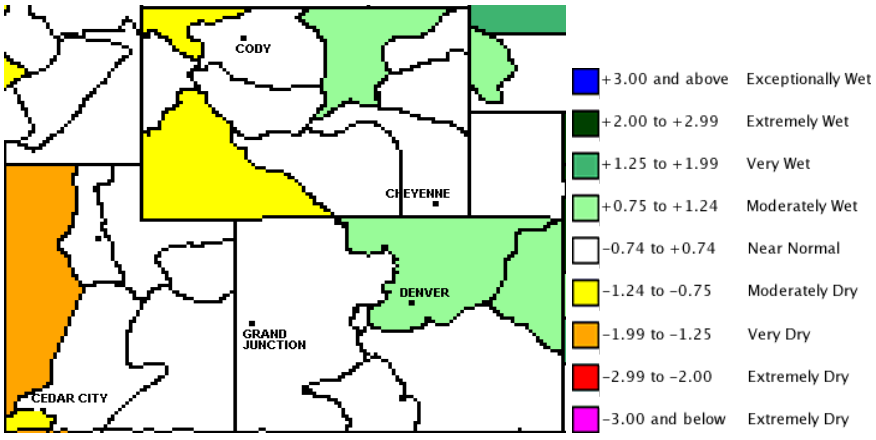

Figure RC-6. 36-month Intermountain West regional Standardized Precipitation Index as of the end of September 2009 (data from 10/01/06Ð9/30/09). (Source: Western Regional Climate Center)

The U.S. Drought Monitor (Figure RC-7) for mid-October has changed significantly since July, with abnormally dry (D0), moderate drought (D1), and severe drought (D2) conditions in southwestern **Colorado** and in the southern portion of **Utah**. A dearth of precipitation and relatively high average temperatures between July and October contributed to a worsening of drought conditions.

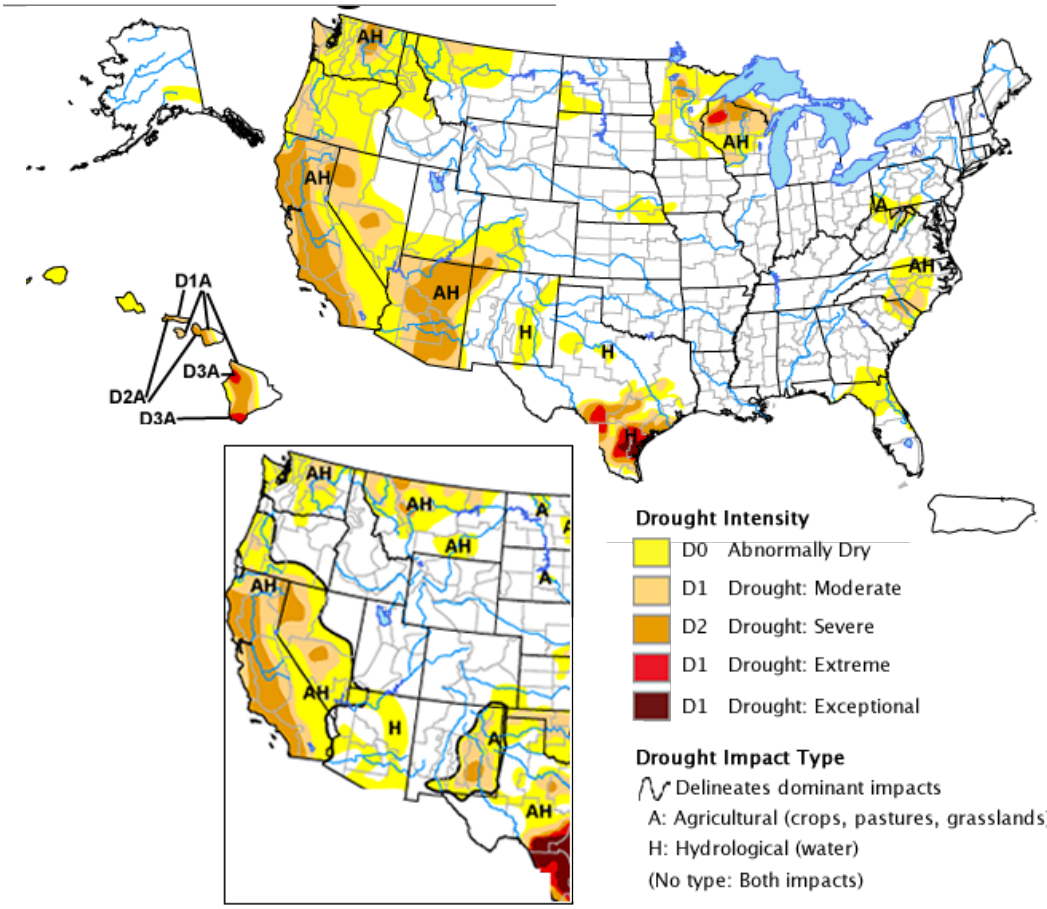

Figure RC-7. Drought Monitor from October 15, 2009 (full size) and July 15, 2009 (inset, lower left) for comparison. (Source: National Drought Mitigation Center)

Intermountain West Snowpack

Snowpack values during October reflect the beginning of the winter snowpack accumulation curve and are poorly correlated with late-season (e.g., April 1) snowpack values. That said, October precipitation and snowfall can be important in alleviating summertime drying of the soil (potentially improving runoff efficiency in the following spring) and in establishing the snow base at regional ski areas. As of October 12, SNOTEL snow water equivalent (SWE) percent of average values in the Intermountain West were highest across **Wyoming** and northern **Colorado** and **Utah**, with the majority of sites in these areas reporting 150% to >200% of average SWE (Figure SP-1). The majority of SNOTEL sites in **Wyoming** reported >200% of average SWE values due to above-average precipitation the state during the first half of October. Wyoming water year-to-date (since October 1, 2009) precipitation ranges from 124Ð181% of average according to NRCS SNOTEL sites. In comparison, inconsistent precipitation across **Utah** and the southern half of **Colorado** is reflected in varying SWE values in these areas as of October 12. In **Colorado**, year-to-date precipitation is near or above average, ranging from 76Ð158% of average with southwestern stations reporting the lowest averages. In central and southern **Utah**, SNOTEL stations are reporting nominal SWE amounts due to below-average precipitation in the first half of October in these areas. Year-to-date precipitation reflects a north-south gradient with the highest percentages (100% to >125% of average) reported in northern **Utah** and the lowest percentages (<45%) in southern basins.

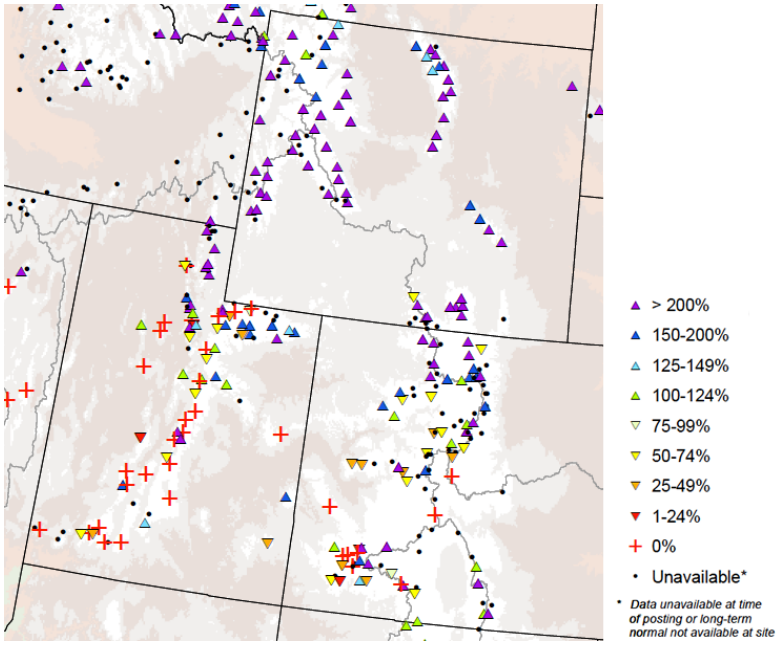

Figure SP-1. Snow-water equivalent as of October 12, 2009 as percent of the long-term average, at SNOTEL sites across the Intermountain West. (Source: Natural Resources Conservation Service)

ENSO Status and Forecast

NOAA scientists announced the arrival of an El Ni–o event in July, and this event continues with monthly sea surface temperature (SST) anomalies remaining 0.5¼C to 1.5¼C above average across the central and east-central equatorial Pacific (Figure EN-1). There has been some waxing and waning of the strength of the anomalies over the past 6 weeks, but NOAA expects that the currently weak El Ni–o conditions will strengthen to a moderate event peaking in the January-March 2010 season, and extend through the MarchÐMay 2010 season. A strong event is less likely, but still possible. (*Note:* Since the release of the NOAA ENSO Diagnostic Discussion in early October, on which this text is based, the current El Ni–o has strengthened to a moderate event.)

The impact of El Ni–o on the climate over North America is expected to be greatest during the winter season, although the event influences the temperature and precipitation outlooks for OctoberÐDecember 2009 through the MarchÐMay 2010 season. Although often associated with negative impacts, El Ni–o typically brings beneficial winter precipitation to the arid Southwest, can help suppress Atlantic hurricane activity, and leads to less wintry weather across the North and a reduced risk of Florida wildfires.

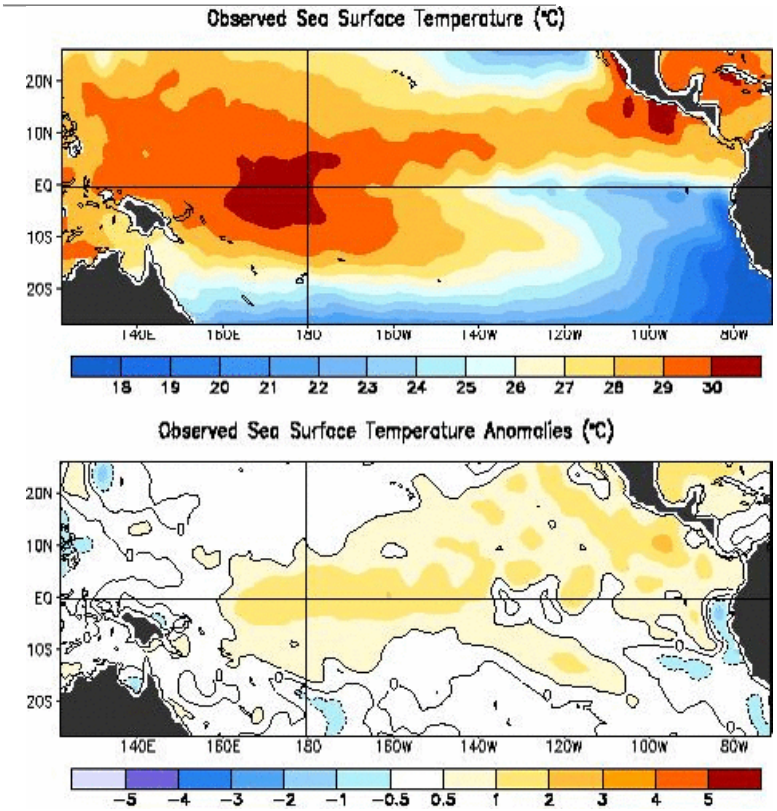

Figure EN-1. Observed SST (upper) and the observed SST anomalies (lower) in the Pacific Ocean. The Ni–o 3.4 region encompasses the area between 120iWÐ170iW and 5iNÐ5iS. The graphics represent the 7-day average centered on October 14, 2009. (Source: NOAA Climate Prediction Center)

According the International Research Institute for Climate and Society (IRI), which partners with NOAA on these outlooks, there is an approximately 90% probability of maintaining at least weak El Ni–o conditions for the OctoberÐDecember and NovemberÐJanuary seasons, and a 10% probability of returning to ENSO-neutral conditions. Probabilities for continuing El Ni–o conditions remain above 80% through the JanuaryÐMarch season, decreasing to 50% by MarchÐMay season and further decreasing to the 25% (the typical climatological probability) by the MayÐJuly season. Across a broad set of dynamical and statistical forecast models, nearly all indicate maintenance of at least weak El Ni–o conditions, or El Ni–o conditions of increasing strength, during the OctoberÐDecember season currently in progress (Figure EN-2).

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

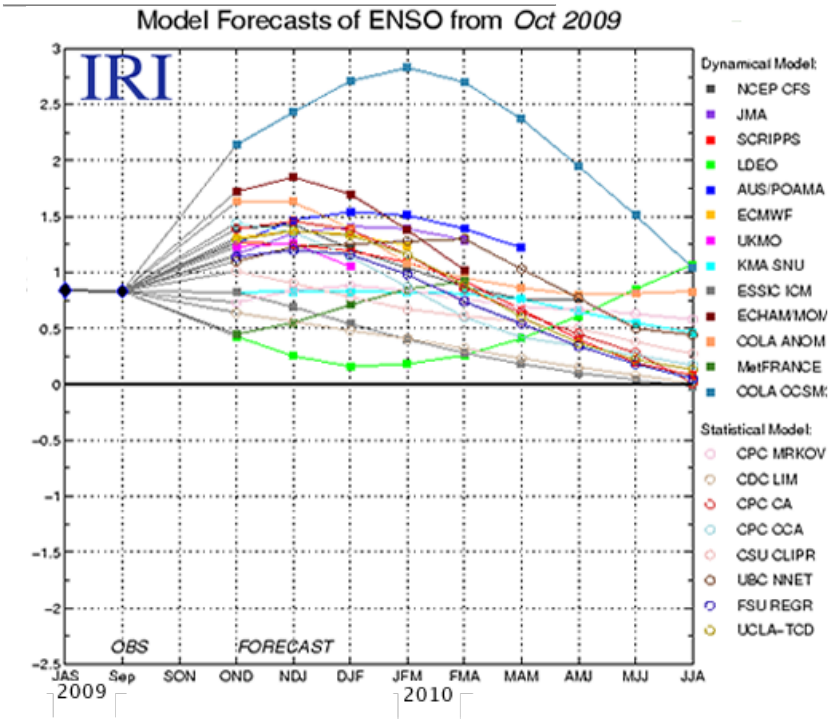

Figure EN-2. Forecasts made by dynamical and statistical models for sea surface temperatures (SST) in the Ni–o 3.4 region for nine overlapping 3-month periods from OctoberÐDecember 2009 to JuneÐAugust 2010 (released October 15, 2009). (Source: International Research Institute (IRI) for Climate and Society)

Temperature Outlook
November 2009–March 2010 (Released October 15, 2009)

The latest temperature outlooks from the NOAA Climate Prediction Center indicate an enhanced risk of above-average temperatures for across much of the West, including all of the Intermountain West, in November 2009 and subsequent seasons (Figures TEMP-1 to TEMP-4).

Temperature impacts of El Ni–o over the U.S. are typically weak during the summer and early fall, and strengthen during the late fall and winter. ENSO composites heavily influence the outlooks for temperature for November and subsequent seasons through the winter. There is an overall trend towards warming conditions in the southwestern U.S.

Note: These climate outlooks are intended for use prior to the start of their valid period (in this case, prior to the beginning of November). Within any given valid period observations and NWS short- and medium-range forecasts should be consulted. The November 2009 temperature forecast will be updated on October 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 November 19th.

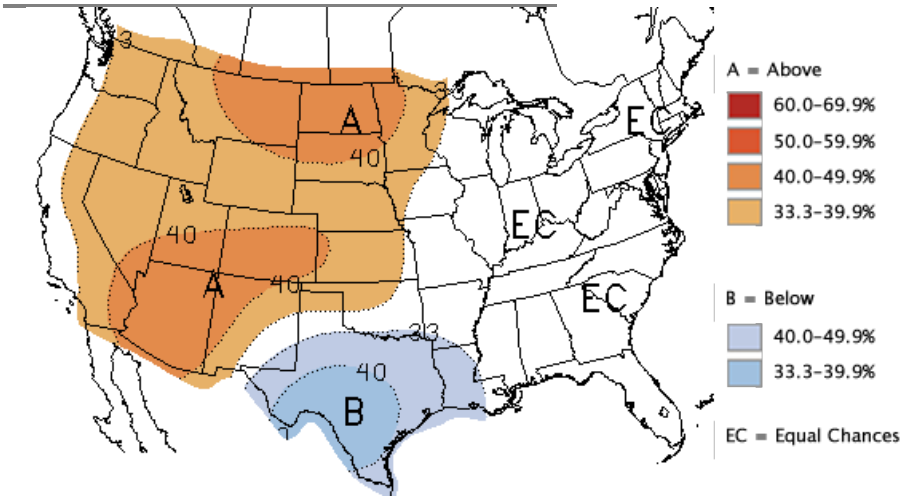

Figure TEMP-1. Long-lead national temperature forecast for November 2009. (Source: NOAA Climate Prediction

Center)

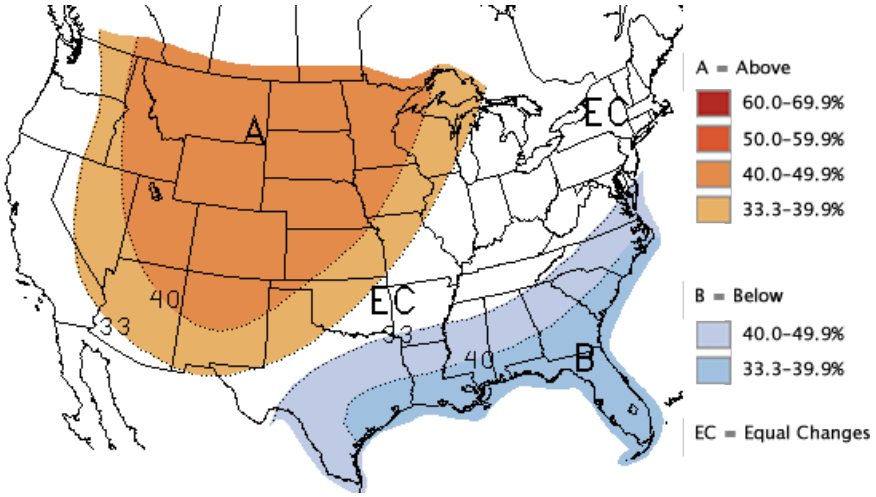

Figure TEMP-2. Long-lead national temperature forecast for November 2009ÐJanuary 2010. (Source: NOAA Climate Prediction Center)

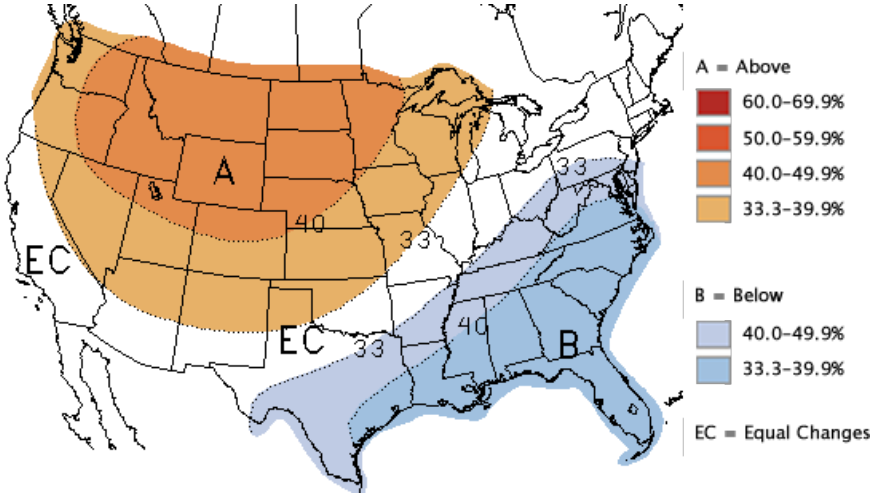

Figure TEMP-3. Long-lead national temperature forecast for December 2009ÐFebruary 2010. (Source: NOAA Climate Prediction Center)

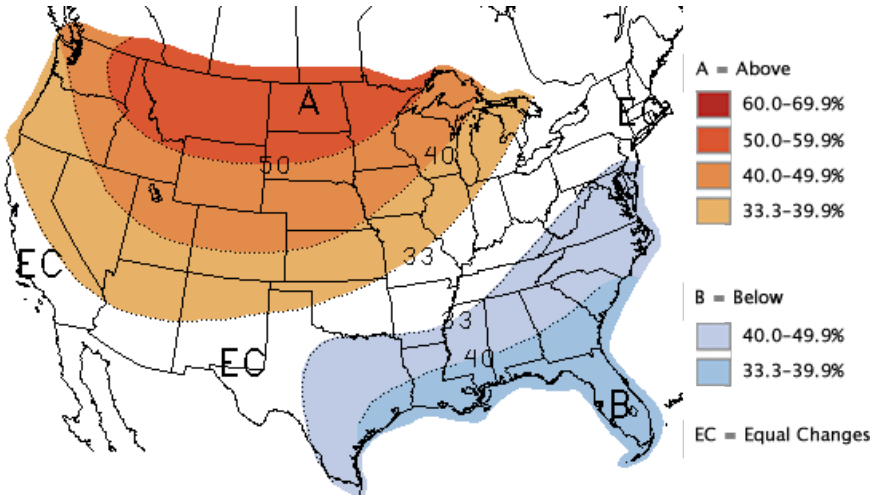

Figure TEMP-4. Long-lead national temperature forecast for JanuaryÐMarch 2010. (Source: NOAA Climate Prediction Center)

Precipitation Outlook
November 2009–March 2010 (Released on October 15, 2009)

The CPC precipitation outlook for November 2009 (Figure PPT-1) shows ÒECÓ ("Equal Chances") for most of the continental U.S., including the Intermountain West. There are no clear signals in the outlook for November or the NovemberÐJanuary season, resulting in a forecast for equal chances for below, near, or above median precipitation (similar to climatology) in the Intermountain West (Figure PPT-1 to -4).

Areas of above- or below-median precipitation are largely due to expected El Ni–o impacts on climate, including the typical El Ni–o-influenced tilt of the odds towards above-median precipitation for some areas of the southern tier, and towards dry 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 November). Within any given valid period observations and NWS short- and medium-range forecasts should be consulted. The November 2009 precipitation forecast will be updated on October 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 November 19th.

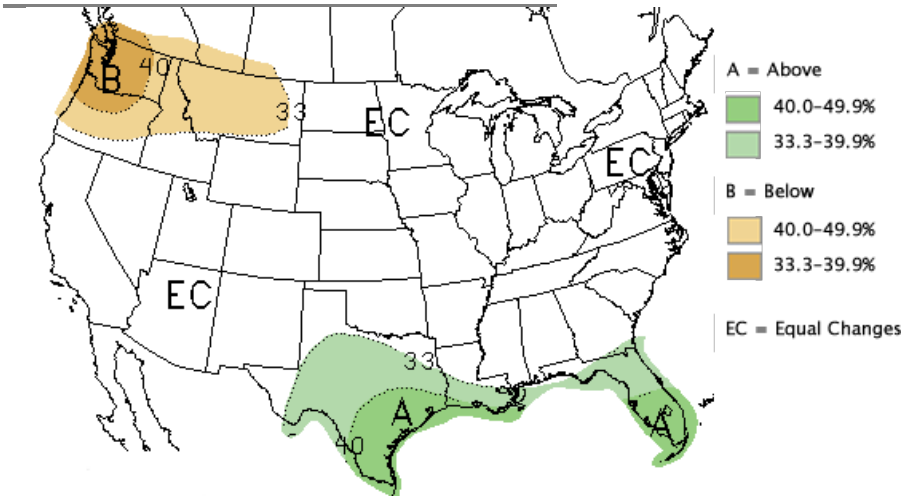

Figure PPT-1. Long-lead national precipitation forecast for November 2009. (Source: NOAA Climate Prediction Center)

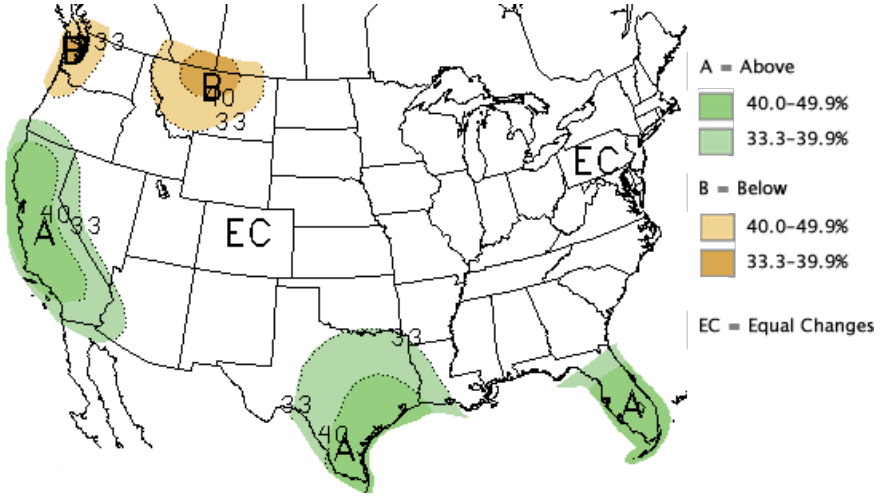

Figure PPT-2. Long-lead national precipitation forecast for November 2009ÐJanuary 2010. (Source: NOAA Climate Prediction Center)

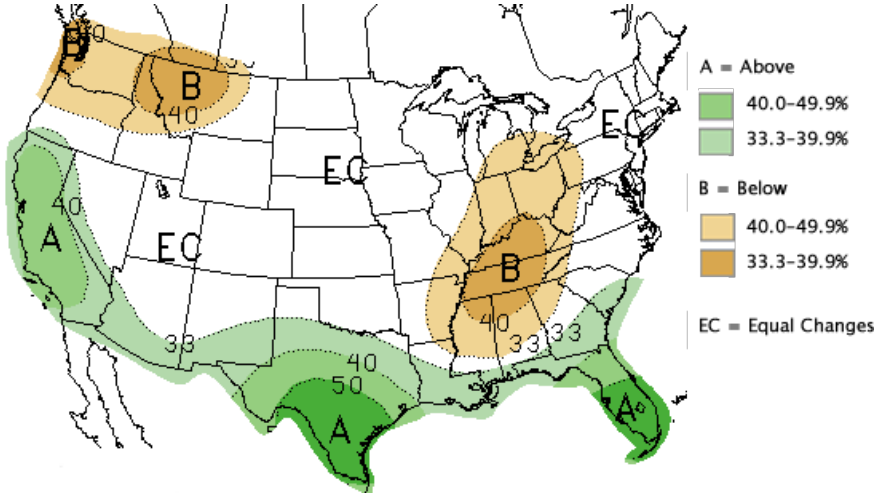

Figure PPT-3. Long-lead national precipitation forecast for December 2009ÐFebruary 2010. (Source: NOAA Climate Prediction Center)

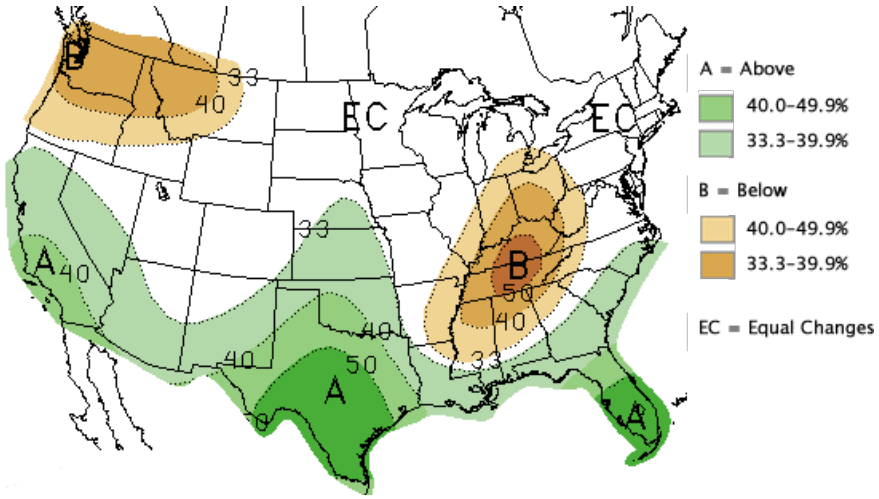

Figure PPT-4. Long-lead national precipitation forecast for JanuaryÐMarch 2010. (Source: NOAA Climate Prediction Center)

As noted in the latest experimental SWcast discussion released on October 23, El Ni–o conditions increased in strength since the end of September. The experimental SWcast forecast guidance for the fall (OctoberÐDecember 2009) shows a tilt towards dry conditions for New Mexico and Arizona, but more neutral for **Colorado** and **Utah** (Figure PPT-5). El Ni–o fall seasons tend to be wet in all four states, so this forecast in part reflects the weak nature of El Ni–o conditions through September. The new late-winter forecast guidance (JanuaryÐMarch 2010) released on October 23, also tilts towards dry conditions for Arizona. The outlook for New Mexico is wet, consistent with El Ni–o expectations, while **Colorado** and **Utah** show a generally dry forecast (Figure PPT-6).

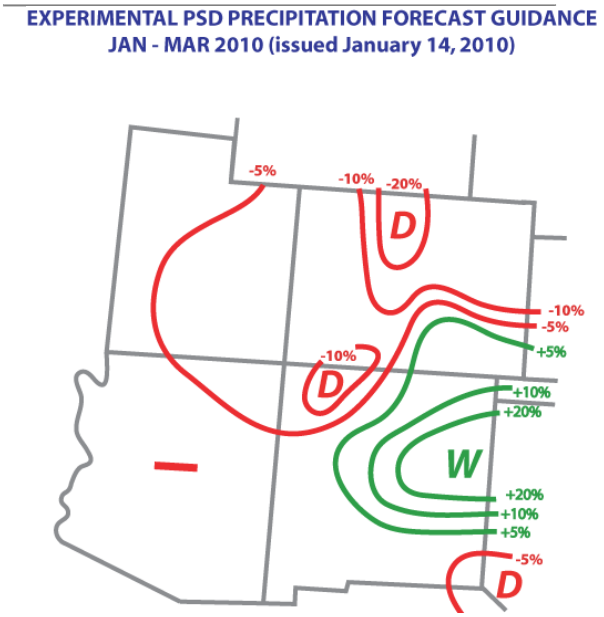

Figure PPT-5. Experimental precipitation forecast guidance. Forecasted shifts in tercile probabilities for OctoberÐ December 2009. (Source: NOAA ESRL Physical Science Division)

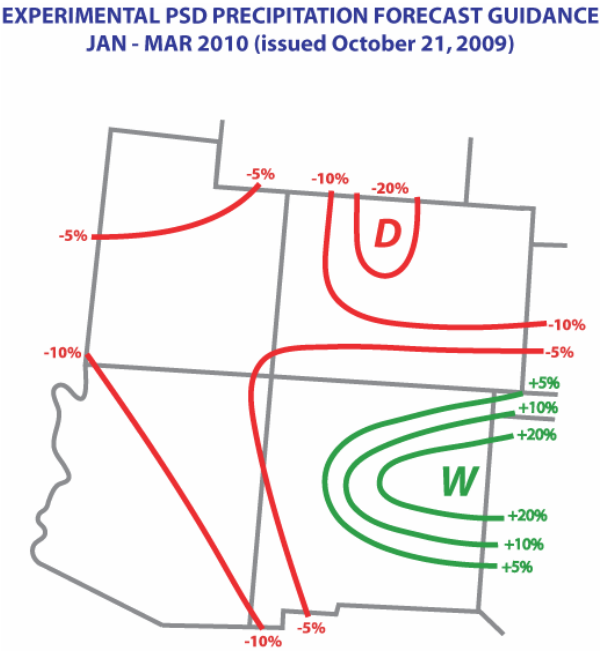

Figure PPT-6. Experimental precipitation forecast guidance. Forecasted shifts in tercile probabilities for JanuaryÐ March 2010. (Source: NOAA ESRL Physical Science Division)

Seasonal Drought Outlook
through January 2010 (Released October 15, 2009)

The October 13 U.S. Drought Monitor indicated that a portion of southwest **Colorado** and southeast **Utah** near the Four Corners is in severe (D2) and moderate (D1) drought status. Besides this area, southern **Utah** and central **Colorado** are the only other areas experiencing abnormally dry (D0) conditions, and **Wyoming** is reporting no drought conditions (Figure RC-7 above). The U.S. Seasonal Drought Outlook builds on the Drought Monitor categories to project how these drought areas might change or where new drought areas might develop. The Drought Outlook is reporting that some improvement is expected by the end of January 2010 in the drought conditions observed in the Four Corners area. The development of new areas of drought is not expected in the Intermountain West for the forecasted period (Figure DO-1).

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 November 5th.

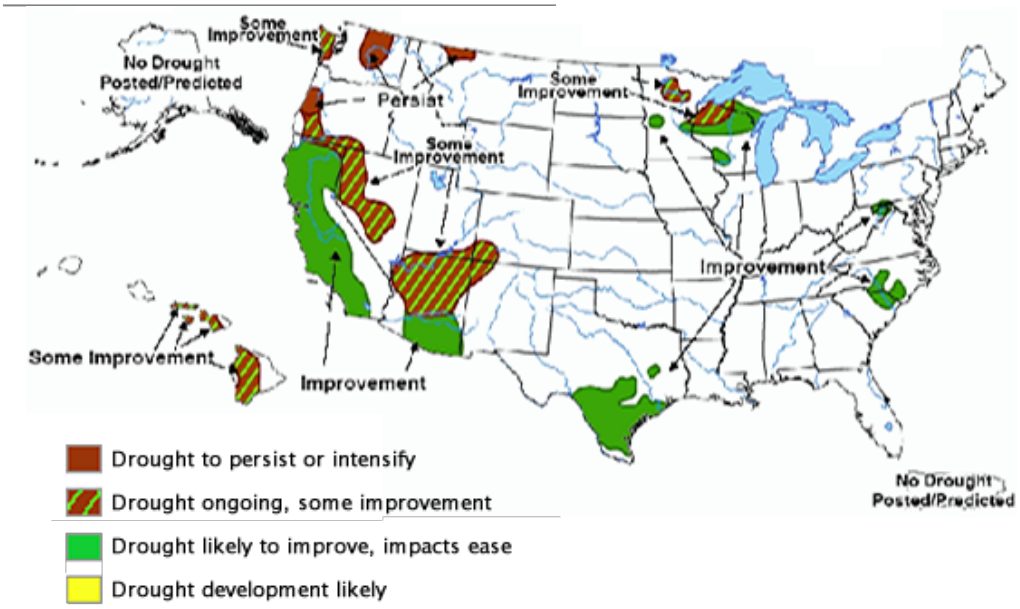

Figure DO-1. Seasonal Drought Outlook for October 15, 2009ÐJanuary 2010. (Source: NOAA Climate Prediction Center)

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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