



Office of the Washington State Climatologist

September 2016 Report and Outlook

September 6, 2016

<http://www.climate.washington.edu/>

August Event Summary

Mean August temperatures were slightly above normal for most of WA state. For precipitation, August, which is typically a dry month with an average of only about 0.95” of precipitation statewide, was even drier than normal. Table 1 shows total August precipitation for a handful of WA stations along with the ranking compared to the historical records (driest to wettest). The example locations were mostly within the top 10 driest Augusts on record, with very little precipitation recorded.

Temperatures were near-normal during the beginning of the month, but the remaining 3 weeks had above normal temperatures with some much warmer than normal temperatures particularly in Western WA. The little precipitation that fell in August occurred mostly during the beginning of the month (or on the last few days; Figure 1), with thunderstorms and showers around the first week of the month. The 9th was a relatively cool day in Eastern WA with both Pasco and Walla Walla recording their lowest high temperature for the calendar day of 80 and 74°F, respectively.

The cool weather did not linger. It became downright hot by mid-month when very warm

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Station	August Precipitation (in)	Rank	Record (in; year)	Records Since
Yakima	T	2 (tie)	0; 1955	1946
Everett	0.10	4	T; 2011	1948
Wenatchee	T	6 (tie)	0; multiple	1959
Ephrata	T	6 (tie)	0; multiple	1949
Pasco	0.04	6	0.01; multiple	1945
SeaTac	0.17	10	T; 2012	1945
Bellingham	0.22	10	T; 1986	1949
Quillayute	0.67	13	0.17; 1998	1966

Table 1: Total August precipitation, the ranking (driest to wettest), the record driest August, and the period of record for selected WA state stations.

temperatures and dry conditions spurred a red flag warning for most of the state. Locations in Western WA set daily high temperature records on the 18th through the 20th. For example, on the 18th, record high maximum daily temperatures were set in Hoquiam (86°F), Bellingham (88°F), Quillayute (96°F), and Vancouver (98°F). On the 19th Bellingham (89°F), SeaTac Airport (95°F), Hoquiam (95°F), Quillayute (96°F), and Vancouver (99°F) set maximum high temperature records as well. Temperatures were comparable on the 20th, with Olympia setting a daily maximum temperature record with 96°F as well as other locations.

A half a dozen fires started on the 21st, damaging homes and other structures and forcing evacuations in Eastern Washington. Air quality in Coeur d'Alene, Idaho reached the “unhealthy” level because of smoke from the Spokane area. At the time of this writing (early September) those fires are under control.

Another ridge of high pressure built into the region a few days later for more record high maximum temperatures in Western WA for the 24th through the 26th. Temperatures were mostly in the upper 80s and lower 90s west of the Cascade Mountains with a notable record high temperature of 92°F in Quillayute on the 25th.

The last few days (8/28-8/31) of the month ended with some precipitation scattered throughout Western WA. For example, Figure 1 shows that Hoquiam got its highest daily precipitation amount of the month on the 31st. It is also worth noting that Hoquiam only received measurable rain on 3 days during August. Typically, measurable rain is recorded on 8 days in August at Hoquiam.

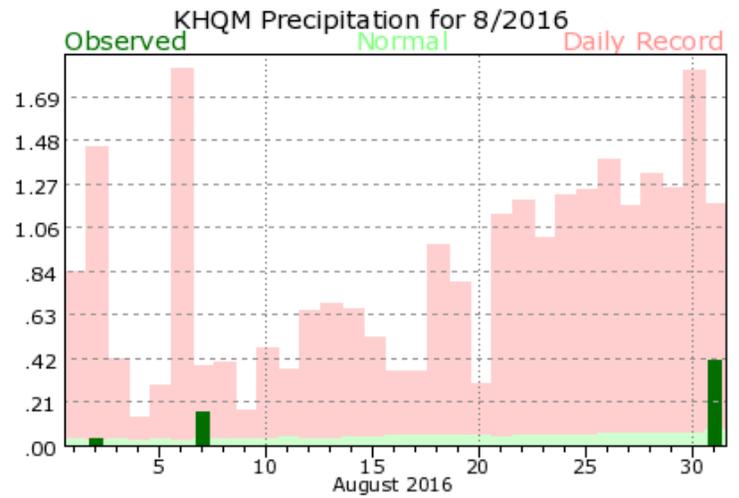


Figure 1: August 2016 daily precipitation for Hoquiam. The green bars are the 1981-2010 normal while the red bars show the daily record maximum precipitation.

Drought Monitor and Streamflow Update

The US Drought Monitor map (Figure 2) released on August 30 still shows “abnormally dry” conditions - “D0” - throughout the entire state. With the drier than usual August, summer (June-Aug) has been dry for a majority of the state. Most locations have been drier than normal since April. Moderate drought - “D1” - was added to portions of Pacific, Lewis, Thurston, and Grays Harbor due to larger precipitation deficits on 60-day and longer time scales and low streamflows in the region. Soil moisture percentiles and streamflows are also low throughout the Olympic Peninsula. At the time of this writing (Sept 1), 28-day average streamflows are much below normal in western WA and in northeastern WA (Figure 3), resulting from the extremely dry August. The conditions depicted on the USDM will deteriorate or improve depending on the timing of the return of fall rains. There have been some drought impacts reported. For example, the Clallam County Public Utility District has requested voluntary water restrictions by users in the Upper Fairview area on the Peninsula due to low streamflow in Morse Creek and Forks has issued emergency water restrictions.

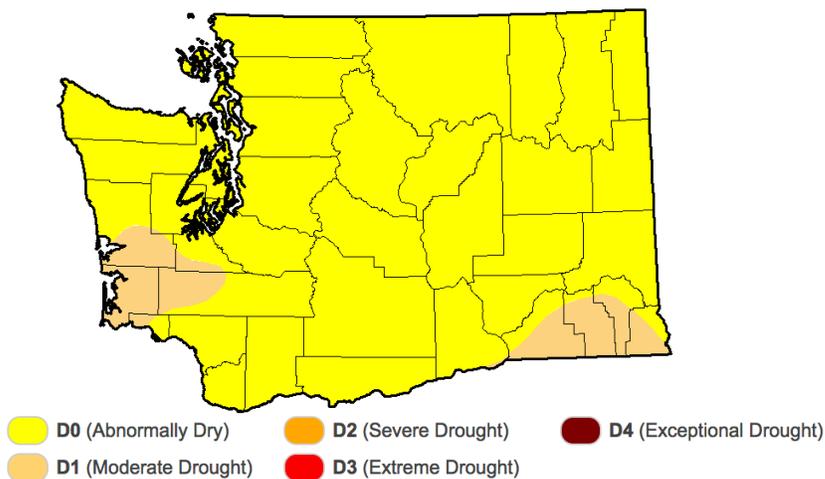


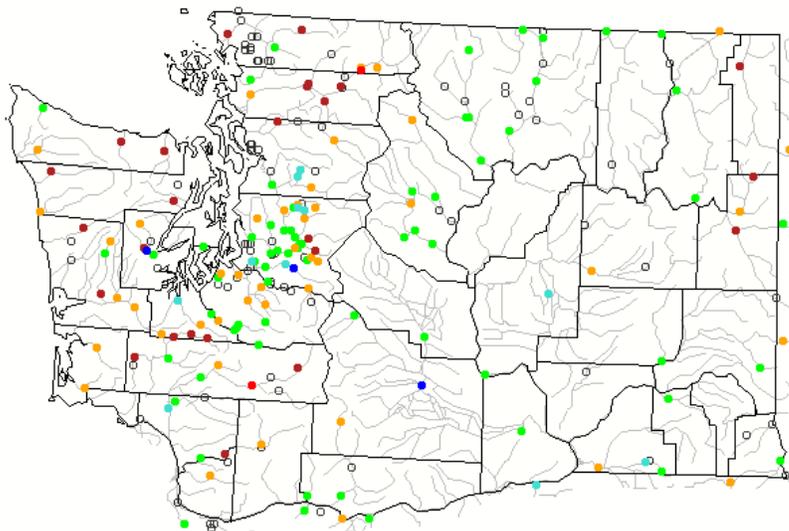
Figure 2: The 30 August 2016 edition of the US Drought Monitor.



Check Out our New Design!

For our regular readers, you’ve probably noticed that our newsletter this month looks very different!

Since we started our newsletter back in 2007, our layout has essentially remained unchanged. We’ve decided that after nearly 9 years, it was time to update our newsletter format. While we’re pleased with the new look, we welcome our readers to submit their feedback to climate@atmos.washington.edu. And you may see some slight changes in the coming months as we work in our new layout. Please keep in mind that our usual content, such as the climate summary, climate outlook, etc., will remain the same.



Explanation - Percentile classes							
●	●	●	●	●	●	●	○
Low	<10 Much below normal	10-24 Below normal	25-75 Normal	76-90 Above normal	>90 Much above normal	High	Not-ranked

Figure 3: The 28-day average streamflow as of 5 September 2016 for WA. From USGS.

1954 - The Year Without a Summer

A message from the State Climatologist

The summer of 2016 in WA state has had kind of a dual personality. From the middle of June into August, near to slightly below normal temperatures mostly prevailed during the part of the year that is typically the warmest. These pleasant conditions were bracketed by some periods of quite warm weather during spring and the second half of August. While the near-normal mid-summer temperatures in WA certainly were not extreme, here we focus on what type of pattern does bring extreme, abnormally cool or wet weather in the summer.

The year of 1954 had the coolest summer (June through August) for WA in the observational record going back to 1895. The statewide average temperature anomaly was -3.4°F compared to the 1901-2000 normal. The summer of 1954 also brought a prolonged and intense heat wave to the Midwest region of the United States. An inverse relationship between the two regions is no coincidence; large anomalies of one sense around here are generally associated with a major perturbation in the large-scale atmospheric circulation that

also produces temperature anomalies of the opposite sense a couple of thousand kilometers away. The objectives of this piece are to illustrate the daily temperatures during the summer of 1954 and how the regional circulation for the summer as a whole compares with that of 1983, which was the wettest on record but not particularly cool.

Time series of daily maximum and minimum temperatures for May-September 1954 (a month was added on each side to show what it was like going in and coming out of summer) are presented for the western WA location of Olympia and the eastern WA location of Ritzville in Figures 4 and 5. There were some occasional warm days, especially in Ritzville, but consistently cool nights. At both locations, nighttime temperatures dipped down to the low 40s or below on multiple occasions, and during the period of June through August daily record lows were set 3 times in Olympia and 5 times in Ritzville. These low minimum temperatures undoubtedly helped push 1954 to the number one spot. Another recent year –

Temperature Summary for OLYMPIA AP
May 1, 1954 - Sep 30, 1954

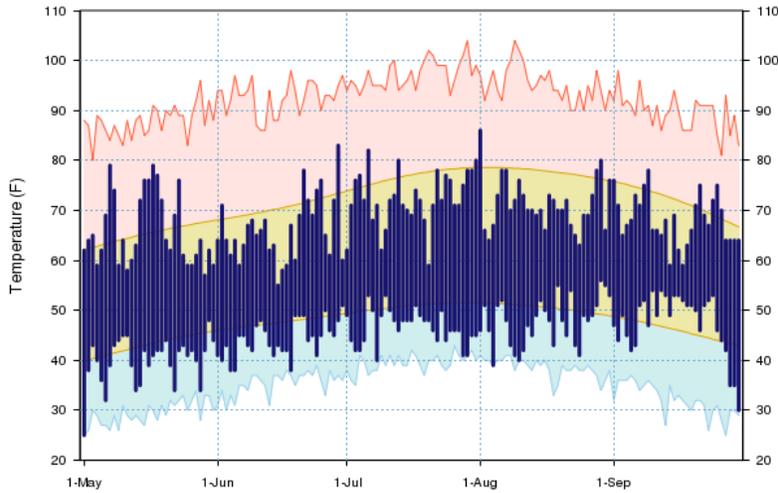


Figure 4: Time series of daily maximum and minimum temperatures at Olympia, WA for 1 May - 30 September 1954. The red trace at the top and the blue trace at the bottom indicate the all-time daily records. The yellow band indicates daily normal max and min temperature for the period of 1981-2010.

1993 – had a similar negative anomaly in magnitude for the maximum temperatures but had exactly normal minimum temperatures. As a result, 1993 was tied for the 4th coolest summer on record in terms of average temperatures.

As for summer precipitation, it was relatively wet in 1954, with a statewide average precipitation total for the period of June through August of 6.00". This amount is 2.20" greater than the 20th century normal and the 7th greatest on record. But it rained a fair amount more in the record wet summer 1983, with a positive anomaly of 3.38". With respect to statewide average temperature, 1983 was only 0.9°F cooler than the 20th century normal. So what's the difference between a record cool summer and a record wet summer in WA state?

The regional atmospheric circulation was different during the especially cool summer of 1954 than during the wettest summer of 1983. As usual, we use 500 hPa geopotential height

(Z) anomaly maps to contrast the two periods. The map for 1954 (Fig. 6) shows a substantial negative anomaly centered over the ocean south of Vancouver Island in a pattern producing anomalous flow from the southwest for WA. This situation favors the landfall of short-wave weather disturbances of North Pacific origin. During the summer these systems tend to be weaker and track farther north than during the winter, but bring plenty of clouds and often some rain to the Pacific Northwest. The 500 hPa map for 1983 (Fig. 7) includes smaller negative Z anomalies over WA and anomalous flow from the southeast. This pattern implies not as strong of a marine influence as in 1954, and instead the Great Basin as a source region to a greater extent than usual. The dregs of monsoonal moisture from the Great Basin can result in significant precipitation in WA state during the summer, especially east of the Cascades, and presumably that happened more than usual in 1983.

Temperature Summary for RITZVILLE 1 SSE
May 1, 1954 - Sep 30, 1954

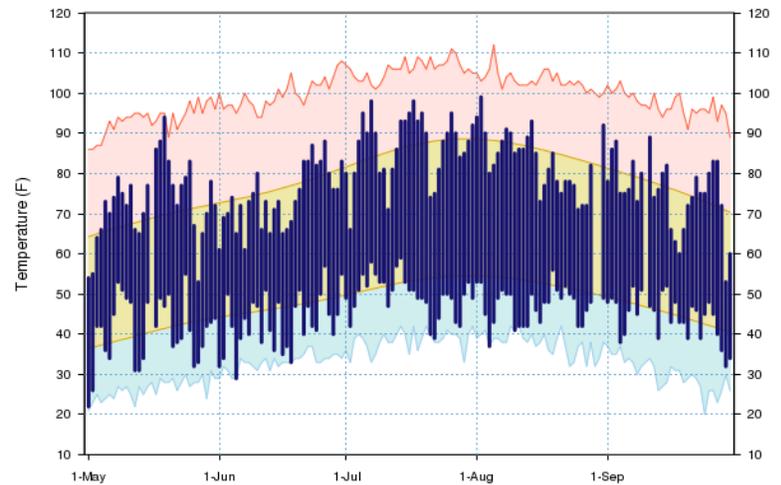


Figure 5: As in Figure 4, but for Ritzville, WA.

Are cool, and for that matter, warm summers just a fluke or are they connected to large-scale modes of the global climate system in a systematic, physically-consistent sense? Are these sorts of situations predictable? Is it possible for mean minimum temperatures in the present and future climate to be as cool as

they were in 1954? The variability of seasonal weather conditions in the Pacific Northwest during winter has garnered a great deal more attention than that during summer but maybe that should not so much remain the case.

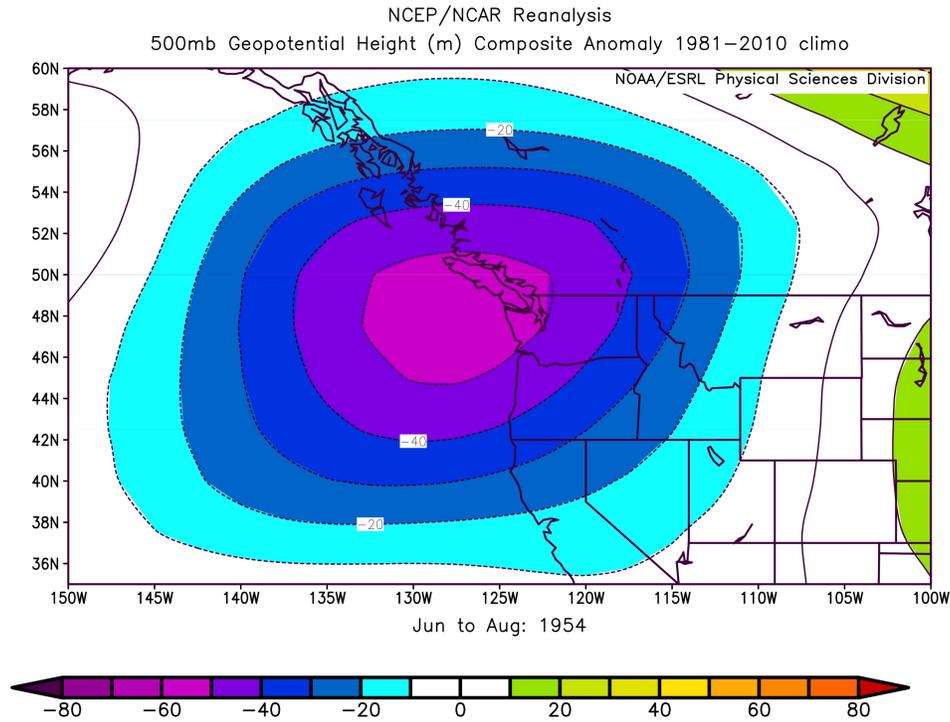


Figure 6: Mean 500 hPa geopotential height anomalies for June through August 1954.

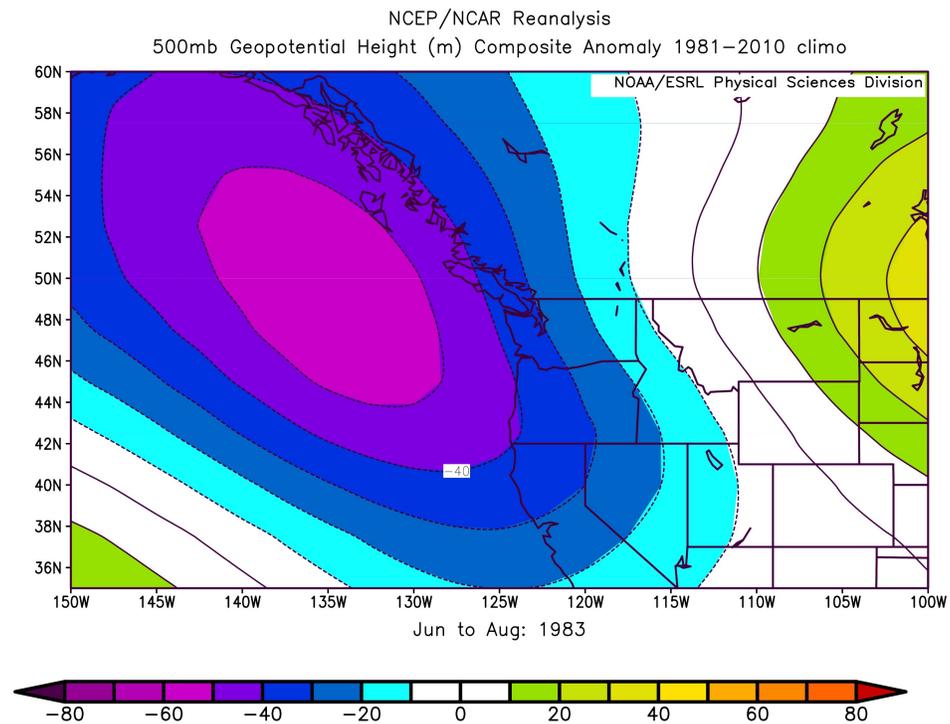
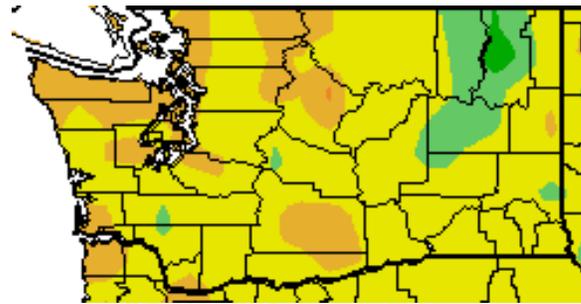


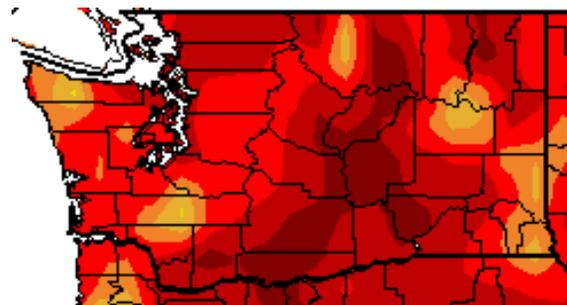
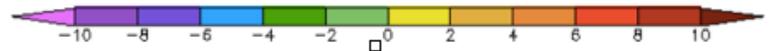
Figure 7: As in Figure 6, but for 1983.

Climate Summary

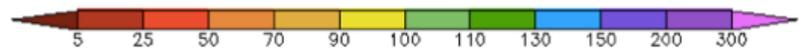
Mean August temperatures were near-normal statewide, with almost all locations within 2°F of normal, according to the High Plains Regional Climate Center map to the right. Even though average temperatures were near-normal, for a majority of the state they were on the warmer side. Spokane Airport and Hoquiam, for example, were 1.9 and 1.7°F above normal, respectively (Table 2). Parts of Western Washington, particularly the Olympic Peninsula, had warmer than normal temperatures for the month. SeaTac Airport and Bellingham were 2.6 and 2.8°F warmer than normal, respectively (Table 2). Eastern Washington experienced slightly cooler and near-normal temperatures this past month. For example, Ephrata and Pasco were both a modest 0.6°F above normal, and Omak was only 0.4°F above normal.



Temperature (°F)



Precipitation (%)



Total August precipitation totals were minimal with most places receiving no more than 30% of normal. Some of the “wetter” spots throughout the state were Olympia, Hoquiam, and Quillayute which received about a half of inch of rain (which ranged from 27 to 46% of normal). Other locations on the east side of the Cascade Mountains, such as Wenatchee, Omak, Ephrata and Hanford, did not receive any measurable precipitation in August.

August temperature (°F) departure from normal (top) and precipitation percent of normal (bottom).

(High Plains Regional Climate Center; relative to the 1981-2010 normal).

	Mean Temperature (°F)			Precipitation (inches)		
	Average	Normal	Departure from Normal	Total	Normal	Percent of Normal
Western Washington						
Olympia	65.5	64.1	1.4	0.40	0.94	43
Seattle WFO	68.6	66.5	2.1	0.05	0.97	5
SeaTac AP	68.7	66.1	2.6	0.17	0.88	19
Quillayute	62.2	59.6	2.6	0.67	2.49	27
Hoquiam	62.3	60.6	1.7	0.60	1.31	46
Bellingham AP	65.3	62.5	2.8	0.22	1.23	18
Vancouver AP	70.2	69.2	1.0	0.20	0.77	26
Eastern Washington						
Spokane AP	71.2	69.3	1.9	0.16	0.59	27
Wenatchee	74.6	73.5	1.1	T	0.20	0
Omak	72.8	72.4	0.4	T	0.49	0
Pullman AP	66.6	65.7	0.9	0.24	0.63	38
Ephrata	73.5	72.9	0.6	T	0.19	0
Pasco AP	73.4	72.8	0.6	0.04	0.27	15
Hanford	76.9	75.8	1.1	T	0.18	0

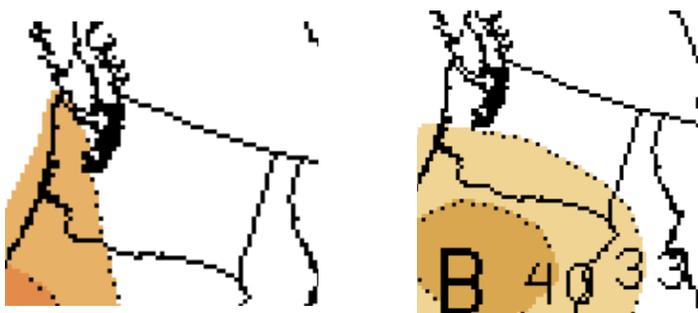
Table 2: August 2016 climate summaries for locations around Washington with a climate normal baseline of 1981-2010. Note that the Vancouver Pearson Airport and Seattle WFO 1981-2010 normals involved using surrounding stations in NCDC's new normal release, as records for these station began in 1998 and 1986, respectively.

Climate Outlook

According to the Climate Prediction Center (CPC), ENSO-neutral conditions still exist, with negative sea surface temperature (SST) anomalies persisting over the equatorial eastern Pacific Ocean. The “La Niña Watch” issued by the Climate Prediction Center is still in effect. Current models continue to indicate a 55-60% chance of a relatively weak La Niña developing during the fall and winter of 2016-17.

The CPC seasonal outlook for September is calling for equal chances of above, equal to, or below average temperatures for most of the state, though parts of western Washington have slightly greater odds for warmer than normal conditions. For precipitation, the September outlook shows a slightly higher chance for below normal precipitation for southern Washington, while the rest of the state favors equal chances of below, near-normal, or above normal precipitation for the month.

The September-October-November (SON) outlook is calling for increased chances of higher than normal temperatures statewide. For precipitation, conditions favor equal chances of below, near-normal, or above normal precipitation totals throughout WA for SON.



September outlook for temperature (left) and precipitation (right)



September-October-November outlook for temperature (left) and precipitation (right)