Office of the Washington State Climatologist

November 5, 2014

October Event Summary

Mean October temperatures were warmer than normal across WA and precipitation was near to above normal for a majority of the state. The exception is the southeast portion of the state where October precipitation checked in below normal. October ranks among the top twenty wettest Octobers for many of the locations that did receive above normal precipitation. Rankings for a sample of those stations with total October precipitation in the top ten are shown in Table 1.

In this Issue

The October temperatures are even more striking. A mean temperature percentile map from the Western Regional Climate Center using PRISM data (Figure 1) shows that mean October temperatures were the record warmest for much of the Puget Sound region and the coast. Mean temperatures were in the top 10% for the remainder of the state. It is worth noting that *both* maximum and minimum temperatures were elevated throughout the month.

Station	October Precipitation (inches)	Ranking	Record (inches)/Year	Records Began
SeaTac	6.75	4	8.96; 2003	1948
Quillayute	17.36	5	27.17; 1975	1966
Everett	6.29	6	8.53; 1975	1894
Bellingham	5.57	8	8.29; 2003	1949
Omak	2.04	8	2.91; 1947	1909
Arlington	8.28	8	9.72; 2009	1922
Chief Joseph Dam	1.43	10	2.04; 1956	1949
Hoquiam	10.55	10	14.68; 1956	1953

Table 1: The total October 2014 precipitation, ranking (from wettest to driest), the current record holder, and the year records began for selected western WA stations.

October started out relatively quiet and warm. Record high daily temperatures were recorded around the state on the 6th with high temperatures even getting into the 90s. Wenatchee recorded 90°F on Oct 6th which is the warmest October day recorded since records be

gan in 1959 as well as a daily record. Seattle (78°F), Omak (85°F), Walla Walla (86°F), Ephrata (88°F), and Yakima (91°F) are a few more examples of daily temperature records broken on the 6th. The summer-like weather did not last through the entire month, however: the spigot was effectively turned on on October 11. This was the same day that a waterspout was spotted over Puget Sound southwest of Tacoma. It did not cause any damage. Daily precipitation records were common throughout the month. For example, record daily rainfall was measured at Olympia (0.56"), Hoquiam (1.18"), and Quillayute (1.92") on the 13th. Heavier rain fell on the 22nd with daily precipitation records set at Moses Lake (0.31"), Omak (0.86"), SeaTac Airport (1.26"), Seattle Weather Forecasting Office (1.39"), Olympia (1.43"), Vancouver (1.70"), and Quillayute (2.44").

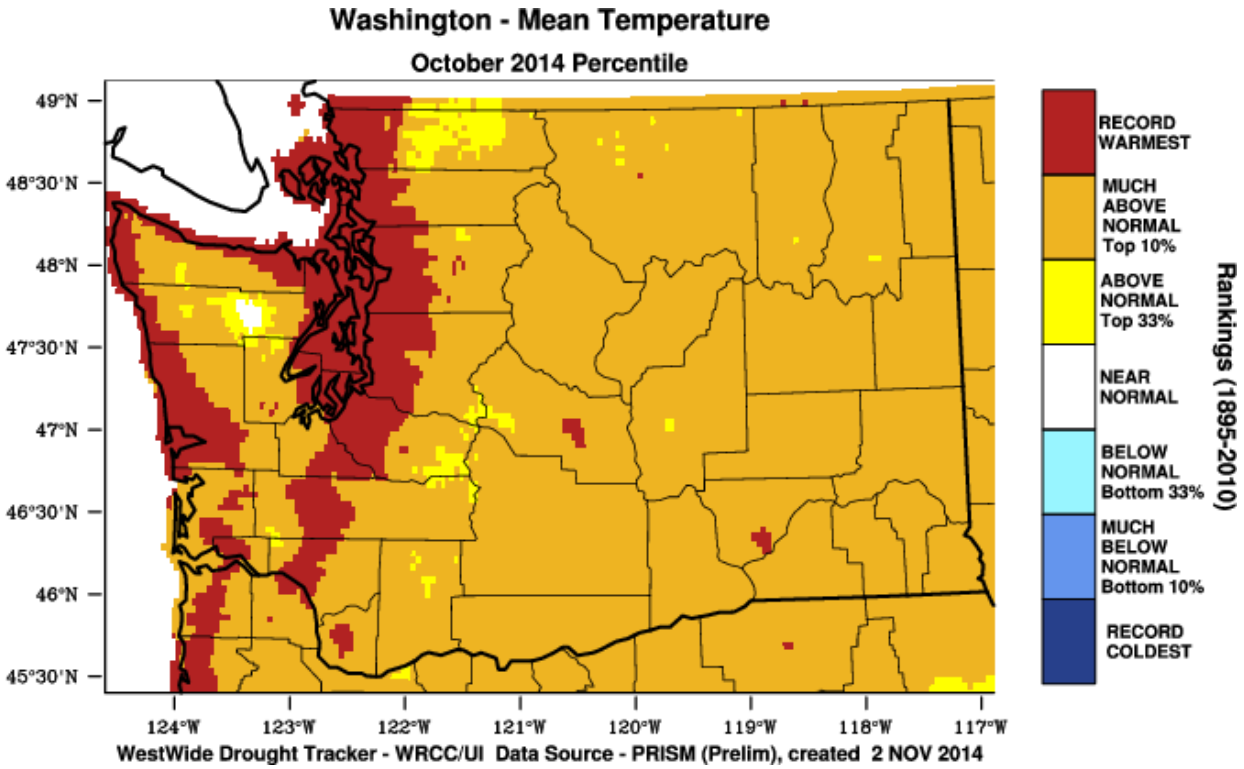


Figure 1: October 2014 percentile temperature for WA State (from the Western Regional Climate Center).

Another notable event was the EF1 (winds > 85 mph) tornado that caused damage in Longview on the afternoon of the 23rd. While the twister caused plenty of property damage (ripped roofs, broken winds, downed trees, etc.), it thankfully did not cause any injuries. The active weather pattern lasted through the end of the month with a wind storm impacting the state on the 25th. Gusts between 30 and 60 mph were reported in western WA while gusts in eastern WA ranged between 35 and 68 mph.

Drought Update

In the last month, there have been some changes to the depiction of conditions in WA state from the US Drought Monitor (Figure 2). The return of fall precipitation to the state has erased any vestiges of dry conditions west of the Cascade Mountains. Improvements to the northern section of central and eastern WA have also been made, and more are on the way in this edition of the Drought Monitor on the heels of another wet week. The remaining drought depictions are largely reflecting dry conditions on a longer time scales, such as those on the 3 to 6-month and longer time scale.

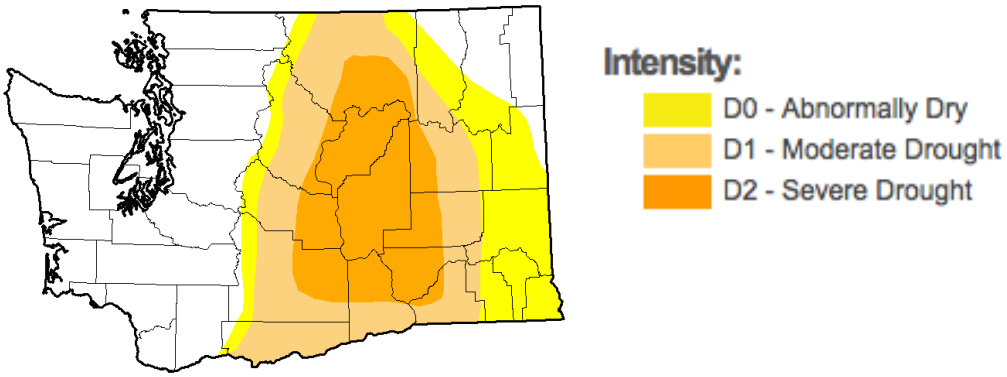


Figure 2: The 28 October 2014 edition of the US Drought Monitor (http://droughtmonitor.unl.edu/).

Cold Season Thunderstorms in WA State

A message from the State Climatologist

A previous newsletter (Aug 2010) included a piece on why thunderstorms are rare in WA State when compared to other parts of the country. Thunderstorms are revisited here, with a focus on their occurrence during the cold season. We look into where they are relatively common or rare across the state, and regional atmospheric variables associated with past cold season events.

Monthly values of thunderstorm frequencies at a variety of stations from a weather almanac published in 1987 are reproduced in Table 2. Mean values over last few decades certainly are different to an extent, but these previous results are likely still valid in general terms. These frequencies to the nearest whole number are also indicated on the Western Regional Climate Center website (http://www.wrcc.dri.edu/climatedata/tables/). Data are available for two coastal stations (there is more complete data for Astoria than for Hoquiam; please do not hold it against us that we are using a location in Oregon), three stations near Puget Sound, the mountain station of Stampede Pass, and three stations in eastern WA.

There exists a reasonably clear signal for the cold season months of November through February relative to the rest of the year. The coast gets relatively frequent events except during February, the Puget Sound region hears the roar of thunder occasionally but less often than other times of year, and the Cascades and eastern WA experience thunderstorms very rarely,

especially compared with during summer. It may not be evident why the seasonality of thunderstorms differs so much, especially between the coast and Puget Sound region. Thus we thought it interesting to examine various weather parameters during past occurrences of thunderstorms.

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Astoria OR	0.6	0.3	0.5	0.6	0.3	0.3	0.4	0.4	0.9	1.0	1.1	1.0	7.3
Quillayute	0.7	0.2	0.5	0.5	0.2	0.1	0.6	0.3	0.4	1.2	1.7	1.1	7.4
Olympia	0.*	0.2	0.2	0.5	0.7	0.6	0.4	0.9	0.7	0.5	0.3	0.1	5.2
SeaTac	0.2	0.3	0.6	0.9	0.9	0.7	0.7	0.8	0.8	0.3	0.6	0.4	7.2
Seattle/Urban	0.3	0.3	0.3	0.4	0.6	0.6	0.7	0.8	0.7	0.6	0.4	0.3	6.0
Stampede	0.0	0.0	0.1	0.2	1.1	1.6	1.3	1.9	0.8	0.2	0.*	0.0	7.2
Yakima	0.0	0.*	0.1	0.4	1.1	1.7	1.5	1.3	0.7	0.1	0.0	0.0	6.8
Walla Walla	0.*	0.1	0.4	0.8	1.7	2.2	2.0	2.1	1.4	0.4	0.1	0.0	11.2
Spokane	0.*	0.*	0.2	0.6	1.4	2.9	2.1	2.3	0.7	0.3	0.1	0.0	10.6

Table 2: Average number of thunderstorm days by month excerpted from Weather of US Cities, Vol. 2, 1987, J. Ruffner and F. Bair, eds. Station records for this tabulation range from 22 to 51 years in length. Entries of 0.* represent average values greater than zero, but less than 0.05.

We have examined regional weather maps for those days itemized in National Climatic Data Center (NCDC) Storm Events database as lightning or thunderstorm wind events in western WA during the months of November through February over the last 20 years. This listing served to be a convenient way to determine the timing of past events, but it should be realized that the listing is restricted to noteworthy incidents that caused damage or injury. The majority of these events (7 out of 9) featured impacts only in counties bordering Puget Sound, but the lack of an impact does not imply that lightning was absent elsewhere. We used 8 of these 9 events to make composite maps using the North American Regional Reanalysis (NARR) data product. The case of 9 November 1996 was excluded from this composite because it did not resemble the other cases at all, but instead something more akin to the typical scenario for thunderstorms during summer, specifically a high-amplitude ridge aloft over the western US.

On the other hand, the mean 500 hPa geopotential height pattern during the 8 winter thunderstorm outbreaks selected (Fig. 3) features a prominent trough of lower heights offshore over the eastern North Pacific and indicates diffluent west-southwesterly flow over western WA. This pattern is conducive to substantial upward motion over western WA, as confirmed by the mean 700 hPa vertical velocities (not shown). We think that the regional distribution of convective available potential energy (CAPE; Fig. 4) is quite interesting. Much higher values (greater static instability) were found over the ocean and the immediate vicinity of the coast than inland, even though the composite is based on times mostly featuring thunderstorms farther inland in locations near Puget Sound, at least in terms of impacts. The enhanced CAPE at the coast can be attributed to the higher surface air temperature and humidity over the water than land (not shown). The presence of especially warm water in the NE Pacific at the time of this writing, affectionately known as the "blob", may stack the deck for more convection than normal in western WA.

We were surprised by the results described above. It was expected that the upper-level trough would tend to be more overhead, i.e. that thunderstorms would be associated with especially

cold-air aloft, as is typically the case during spring. Instead, based on our admittedly simple analysis, deep and vigorous enough convection to promote the electrification of clouds may be more dependent on the forcing of strong upward motion, presumably as long as there at least modest instability.

It should be recognized that while the 8 cases in the composites shown here all resembled one another, there are other ways that deep convection can occur in WA state during the winter. Occasionally it is apparently cold enough aloft to support thunderstorms during wintry weather. A notable example is represented by the marvelous storm of 18 December 1990 when the central and northern portion of Seattle experienced a few claps of thunder during a short period of very heavy snowfall. More commonly, the Puget Sound Convergence Zone can generate some lightning, often accompanied by ice pellets or snow if temperatures are close enough to freezing.

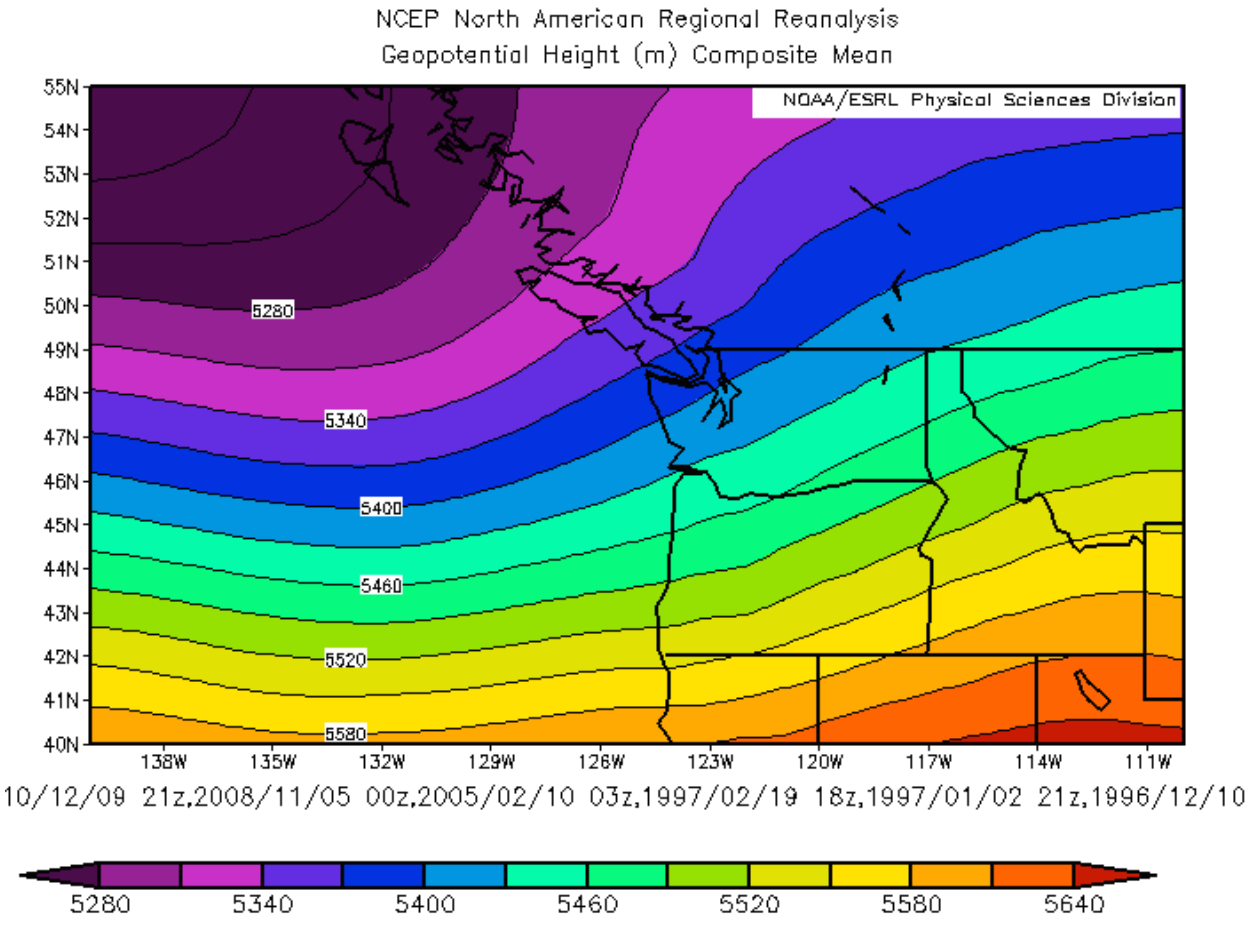


Figure 3: Composite 500 hPa geopotential height (m) for 8 thunderstorm events associated with damage or injury in western WA during the winter months of November through February.

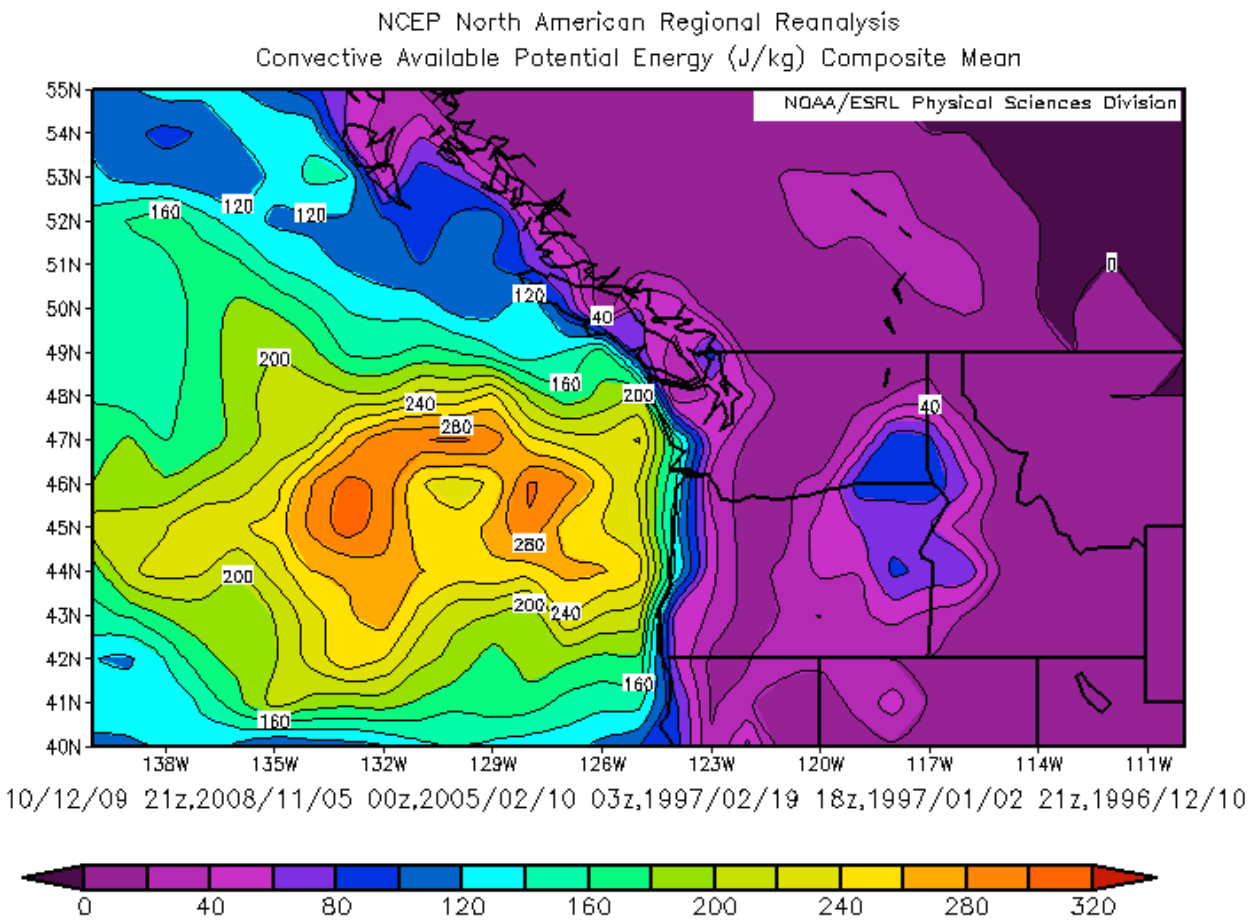


Figure 4: As in Figure 3, but for convective available potential energy (CAPE; J/kg).

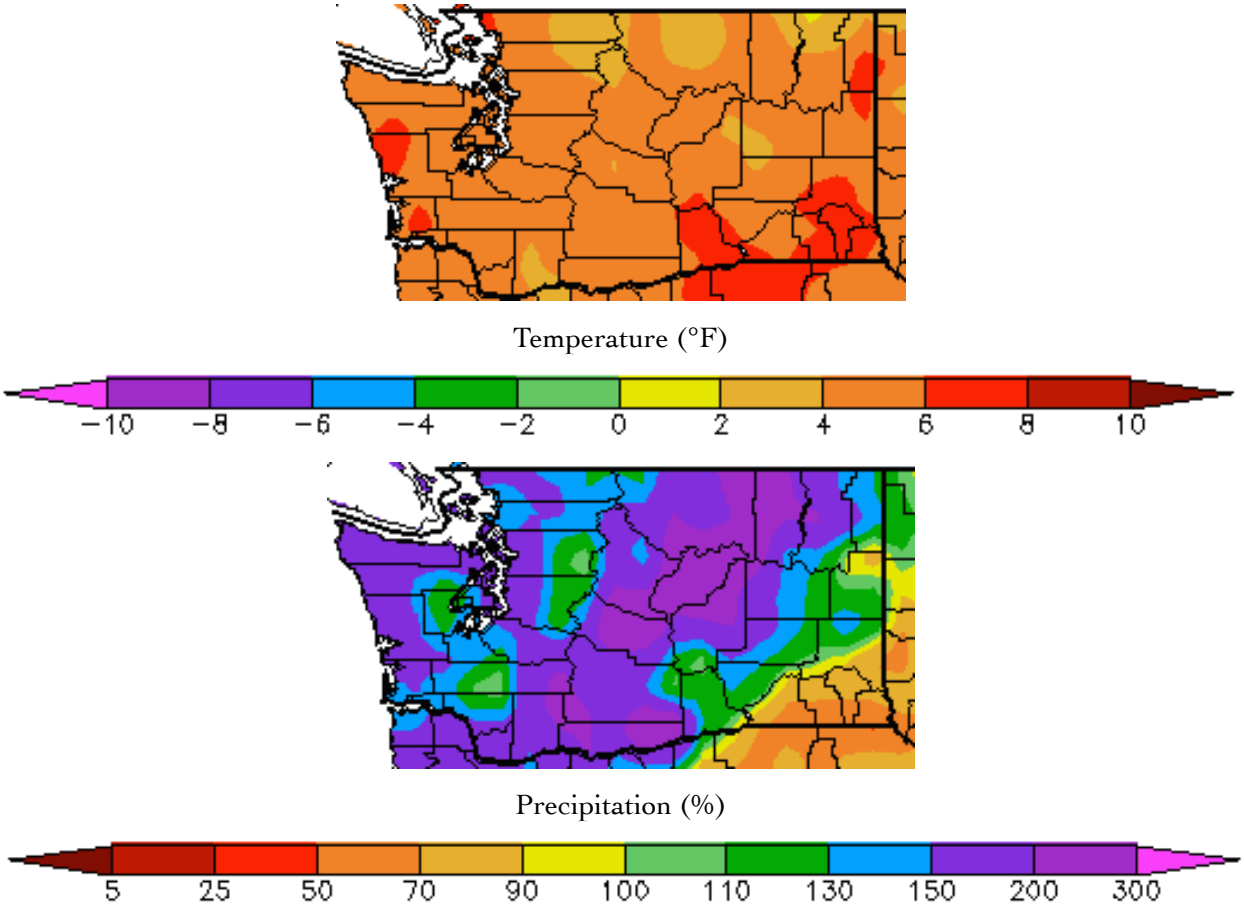
IPCC Report Released

The Working Group II full report has been released. This report is the Impacts, Adaptation, and Vulnerability section of the tome, which may be of interest to some of our readers. The Summary for Policymakers and the full report is available here: http://www.ipcc.ch/report/ar5/wg2/.

Climate Summary

Mean October temperatures were much warmer than normal across all of WA State, as shown in the map below from the High Plains Regional Climate Center. The warmer than normal October temperatures mark the fourth consecutive month with above normal temperatures across the majority of WA State. For October, the average temperatures were mostly between 4 and 6°F, with a few areas especially in southeast WA, such as Pullman (Table 3), exceeding 6°F. Bellingham was another warm spot, with average October temperatures 6.6°F above normal.

Total October precipitation was normal to above normal for nearly the entire state. Much-needed precipitation fell throughout central and north central WA with amounts between 150 and 300% of normal. For example, Wenatchee and Ephrata received 211 and 215% of normal, respectively (Table 3). Western WA was wetter than normal as well, with monthly amounts totaling between 110 and 200% of normal. Southeast WA was the anomaly, only receiving between 50 to 90% of normal precipitation for the month (e.g., only 76% of normal occurred in Pullman).



October temperature (°F) departure from normal (top) and October precipitation % of normal (bottom). (High Plains Regional Climate Center (http://www.hprcc.unl.edu); relative to the 1981-2010 normal).

	Mean Temperature (°F)			Precipitation (inches)		
	Average	Normal	Departure from Normal	Total	Normal	Percent of Normal
Western Washington						
Olympia	55.8	50.3	5.5	6.91	4.60	150
Seattle WFO	58.6	53.3	5.3	6.77	3.41	199
SeaTac AP	58.0	52.8	5.2	6.75	3.48	194
Quillayute	56.3	50.0	6.3	17.36	10.49	165
Hoquiam	57.7	52.2	5.5	10.55	6.53	162
Bellingham AP	56.4	49.8	6.6	5.57	3.68	151
Vancouver AP	59.0	53.8	5.2	6.03	3.07	196
Eastern Washington						
Spokane AP	53.3	47.6	5.7	1.42	1.18	120
Wenatchee	56.5	50.9	5.6	0.93	0.44	211
Omak	52.9	48.9	4.0	2.04	1.10	185
Pullman AP	53.8	47.5	6.3	1.02	1.34	76
Ephrata	55.9	50.5	5.4	1.14	0.53	215
Pasco AP	57.3	51.9	5.4	0.71	0.65	109
Hanford	58.7	53.1	5.6	0.77	0.49	157

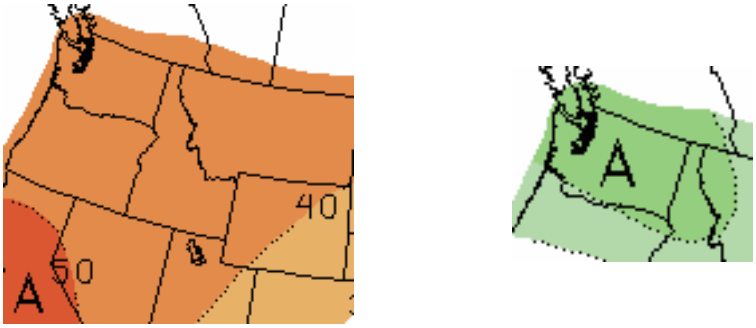
Table 3: October climate summaries for locations around Washington with a climate normal baseline of 1981-2010. Note that the Vancouver Pearson Airport and Seattle WFO 1981-2010 normals involved using surrounding stations in NCDC's new normal release, as records for these station began in 1998 and 1986, respectively.

Climate Outlook

Neutral ENSO conditions still exist in the equatorial Pacific Ocean, according to the Climate Prediction Center (CPC): http://www.cpc.ncep.noaa.gov. Averaged over the last month, the sea-surface temperatures (SSTs) are warmer than normal throughout the entire equatorial Pacific Ocean. The "El Niño Watch" that was initially released by the CPC in early March is still in effect. The latest update from the CPC states that "El Niño is favored to begin in the next 1-2 months and last into the Northern Hemisphere spring 2015".

The Climate Prediction Center seasonal outlook for November is persistence, and is predicting a very similar outcome to what occurred in October. There is an increased chance of higher than normal temperatures across the entire state. Precipitation, on the other hand, has increased chances of above normal precipitation statewide, largely due to the enhanced precipitation expected during the first week of November. However, it looks as if the second week of the month will be on the dry side.

The November-December-January (NDJ) CPC outlook also has higher chances of warmer than normal temperatures across the state, with higher chances west of the Cascade Mountains. The NDJ precipitation outlook calls for increased chances of below normal precipitation, particularly in far eastern WA.



November outlook for temperature (left) and precipitation (right) from the CPC.

November-December-January outlook for temperature (left) and precipitation (right) from the CPC.