Office of the Washington State Climatologist

December 3, 2014

November Event Summary

Mean monthly temperatures were near-normal for much of the state, with a tendency towards below normal mean temperatures, especially east of the Cascade Mountains. Despite the near-normal mean temperatures, there were actually some large temperature swings throughout the month. The see-saw nature of the temperatures throughout WA State is illustrated in Figure 1, using the daily temperatures from Spokane Airport. Total November precipitation was below normal for most of the state, thanks largely to the stagnant weather pattern that dominated during the middle of the month, which is illustrated by the colder than normal temperatures in Figure 1.

In this Issue

November began on a wet note with the heaviest precipitation of the period falling on the 3rd. Quillayute received nearly half of its total monthly precipitation on that day, setting a daily precipitation record for November 3rd with 4.20". Very mild temperatures meant that the precipitation fell as rain even at higher elevations causing some minor flooding in western WA. A high temperature of 72°F was recorded at Walla Walla on the 5th, setting a daily high temperature record. Warmer than normal temperatures lasted on the 6th, setting daily high temperature records in Pullman (68°F), Chief Joseph Dam (63°F), Wenatchee (63°F), and Omak (60°F), for example, as well as records for high low temperatures at Ephrata (46°F) and Wenatchee (46°F) for the same date.

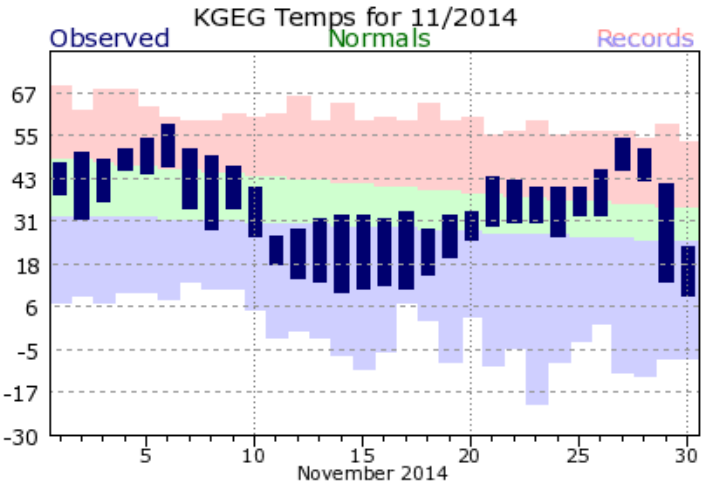


Figure 1: The daily high and low temperatures in November (bars) for Spokane Airport. The green envelope represents normal temperatures and the blue and red are past daily records (from NWS).

A ridge of high pressure began building on the 7th, ushering in much cooler air. The pattern was quite robust, as mentioned in the opening paragraph, and the colder than normal temperatures

stuck around for over a week. Record low daily temperatures were set across the state on November 16th; examples include Goldendale (-5°F), Yakima (8°F), Olympia (16°F), and Vancouver (19°F). The persistent cold and stable air trapped pollutants close to the surface and resulted in stagnant air advisories towards the end of period.

The pattern did finally change again on the 20th/21st with precipitation falling statewide, gusty winds, and some snow in the mountains. Temperatures quickly warmed up again, however, so that the wet period through the Thanksgiving holiday was mild enough for the precipitation to fall as rain in the mountains causing some flooding. The temperatures were remarkably warm - about 10-15°F warmer than normal around the state - and daily temperatures records were set over the holiday. For example, on the 26th, Vancouver (62°F) and SeaTac Airport (59°F) set daily high temperature records. On Thanksgiving Day (the 27th), Yakima (64°F), Ephrata (61°F), Olympia (58°F), SeaTac Airport (58°F; tie), and Hoquiam (57°F; tie) all set daily high temperature records. Heavy rain fell in western WA on the 28th, but then colder air moving in on the 29th changed some of that precipitation over to snow, marking the first lowland snow event in western WA of the season. Accumulations were light, and Figure 2 from the Community, Collaborative Rain, Hail, and Snow (CoCoRaHS) network illustrates observed values on the morning of the 29th. The weather remained cold to close out the month. Temperatures were about 10-15°F below normal with record low daily minimum temperatures measured at Walla Walla (4°F), Bellingham (18°F; tie), Quillayute (19°F), and Seattle (24°F) on November 30.

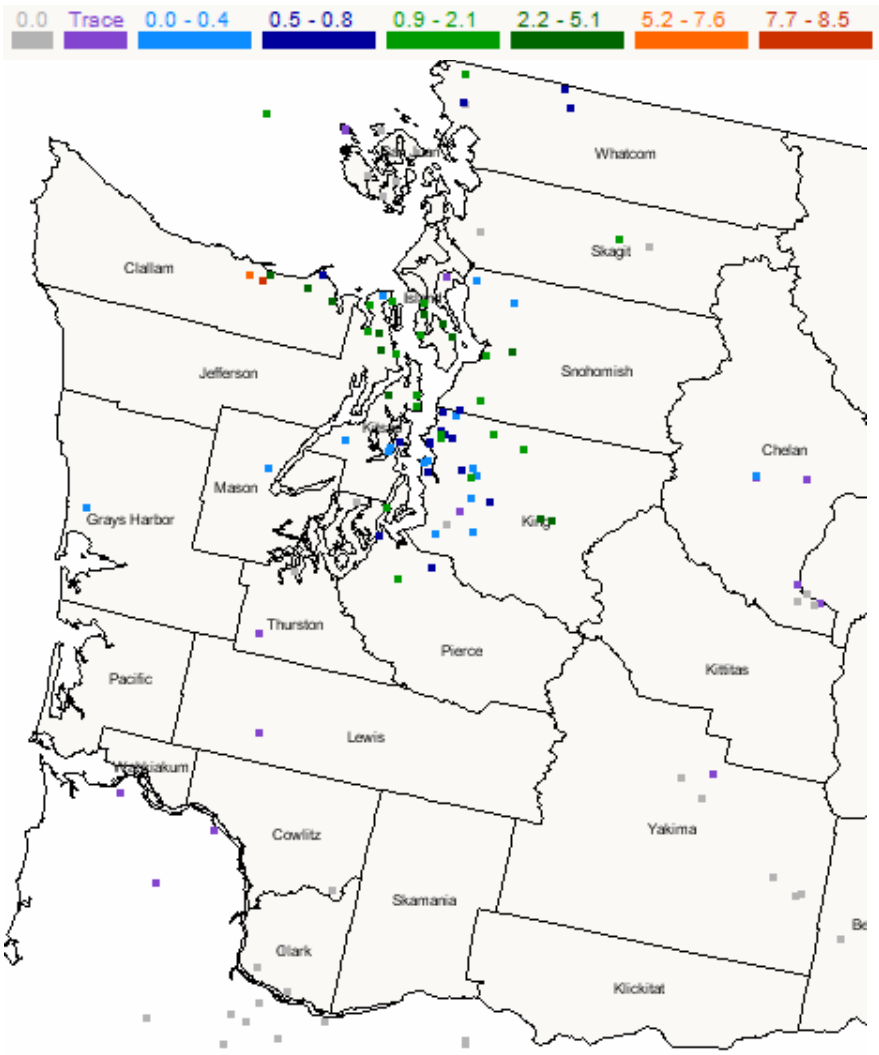


Figure 2: 24-hr snowfall (inches) report from CoCoRaHS observers on the morning (between 7 am and 9 am) of November 29, 2014.

Snowpack and Drought Update

There have been some changes to the US Drought Monitor depiction of dry conditions in WA state over the last month (Figure 3). The normal to above-normal precipitation in the northern Cascades and Okanogan County over the last month as well as on longer time scales has helped to alleviate the dry conditions there and improvements have been made. The continued dryness in southeast WA has warranted an extension of the D1 conditions - moderate drought - to connect with the borders of Oregon and Idaho. The snowpack has had a slow start (Figure 4), and these values will continue to be monitored as the winter progresses. The snow water equivalent (SWE) normals are fairly low for this time of the year so a couple of good snow storms would improve the percent of normal numbers shown in Figure 4 immensely.

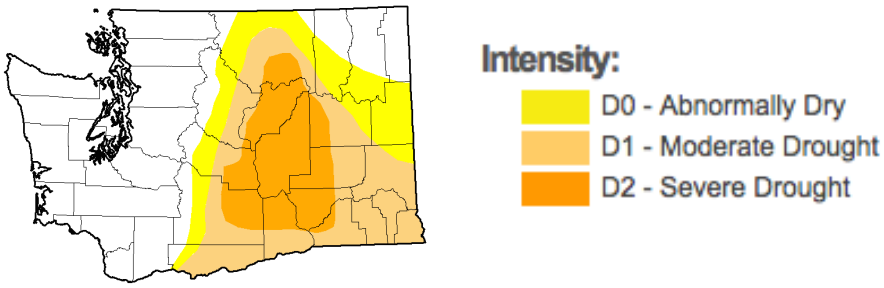


Figure 3: The November 25, 2014 edition of the US Drought Monitor (http://droughtmonitor.unl.edu/).

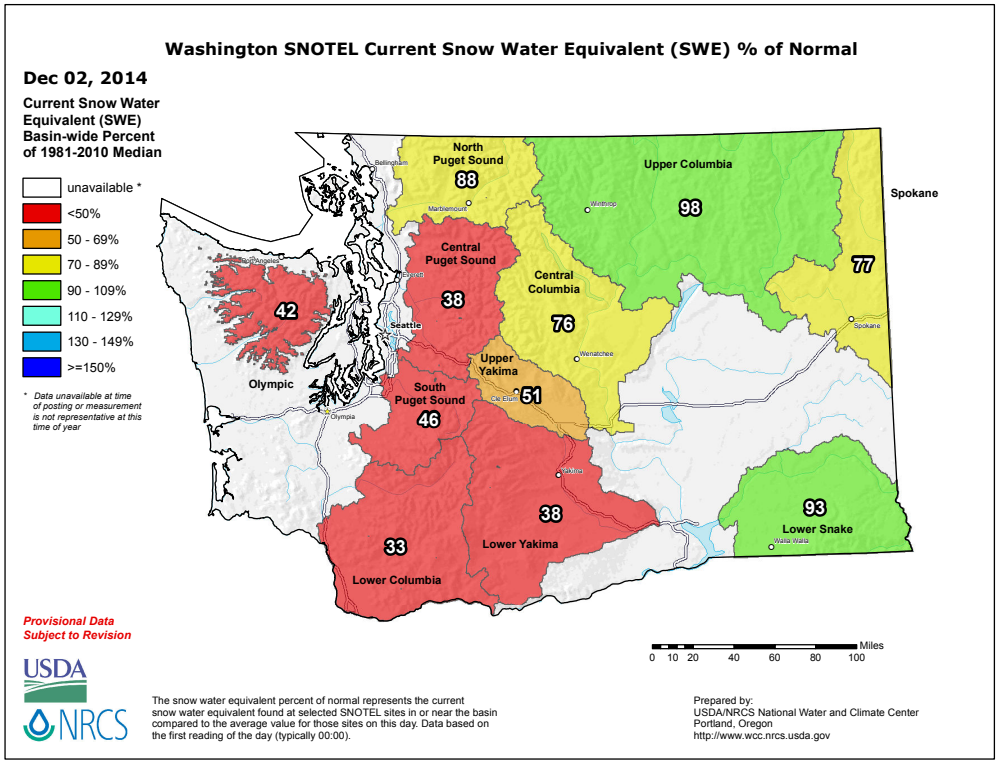


Figure 4: Snowpack (in terms of snow water equivalent) percent of normal for Washington as of December 2, 2014 (from the National Resources Conservation Service).

Precipitation along the West Coast: California versus Washington

A message from the State Climatologist

California is desperate for water. Precipitation totals in the Golden State have generally been sub-par since the late 1990s, with last winter being especially extreme (the third driest in the record extending back to 1896). While they are hurting, the Pacific Northwest needs its water too, which raises the following question: Is it a case of us versus them? Readers of this newsletter may already know that there is a sort of yin-yang in wintertime precipitation along the west coast in association with El Niño-Southern Oscillation (ENSO). A weak El Niño is liable to be in the cards. The sea surface temperature is quite warm in the central and eastern tropical Pacific Ocean, but to date, there has been little response in terms of the deep cumulus convection. If El Niño finally gets its act together, and the movie stars get to fill their swimming pools, does it mean we are probably doomed to less lowland rain and meager mountain snow packs?

To address that question we have considered the historical record over the past 65 years. The precipitation at SeaTac Airport (SEA) for the months of October-March each year is used as a measure of cool season precipitation for Washington state. These totals have been compared with their counterparts at various locations along the west coast. It should come as absolutely no surprise that the seasonal totals at SEA correspond closely with the totals at nearby locations such as Portland (PDX). Here the focus is on California, and the seasonal totals at Los Angeles (LAX) and San Francisco (SFO) are used for that purpose. This data was gleaned from the "Climate at a Glance" website maintained by NOAA/NCDC (http://www.ncdc.noaa.gov/cag/time-series).

First, it seems worthwhile to examine the mean atmospheric circulation pattern associated with precipitation in Washington state. As commonly done in this corner, we characterize the circulation by way of the 500 hPa geopotential height (Z). Figure 5 shows the distribution of the correlation coefficient between the seasonal mean 500 hPa Z and precipitation at SEA. This pattern indicates that wet (dry) winters tend to be accompanied by relatively low (high) 500 hPa Z values over southeast AK with values in the opposite sense to the south along about 30 N across the eastern Pacific into the southwestern US. In other terms, westerly (easterly) anomalies in the flow aloft are associated with wet (dry) winters in our backyard. The overall pattern resembles, but does not closely match, the 500 hPa Z associated with the Pacific North American (PNA) teleconnection pattern (not shown). The PNA features "centers of action" or poles in the central North Pacific and Gulf of Alaska/western Canada that are shifted about 20 degrees longitude to the east, and an overall magnitude about 1.5 times greater than that shown in Figure 5. While the PNA corresponds with the weather of the Pacific Northwest, that its pattern does not match Figure 5 provides a good example that a single climate index is often insufficient for characterizing the state of the circulation for a region.

The relationship between seasonal precipitation totals at SEA versus LAX and SFO in California are summarized in terms of the scatterplot shown in Figure 6. Wetter winters at SEA

tend to be accompanied by drier winters at LAX, and vice versa, with plenty of scatter. But there is virtually no relationship between the precipitation anomalies at SEA and SFO. Referring back to Figure 5, when it is wet at SEA higher 500 hPa Z and NE flow anomalies are favored over LAX, which is unfavorable for precipitation. It is a more of a mixed message for SFO, however, which experiences slightly higher 500 hPa Z but also westerly flow anomalies, with the apparent result of little net effect on precipitation.

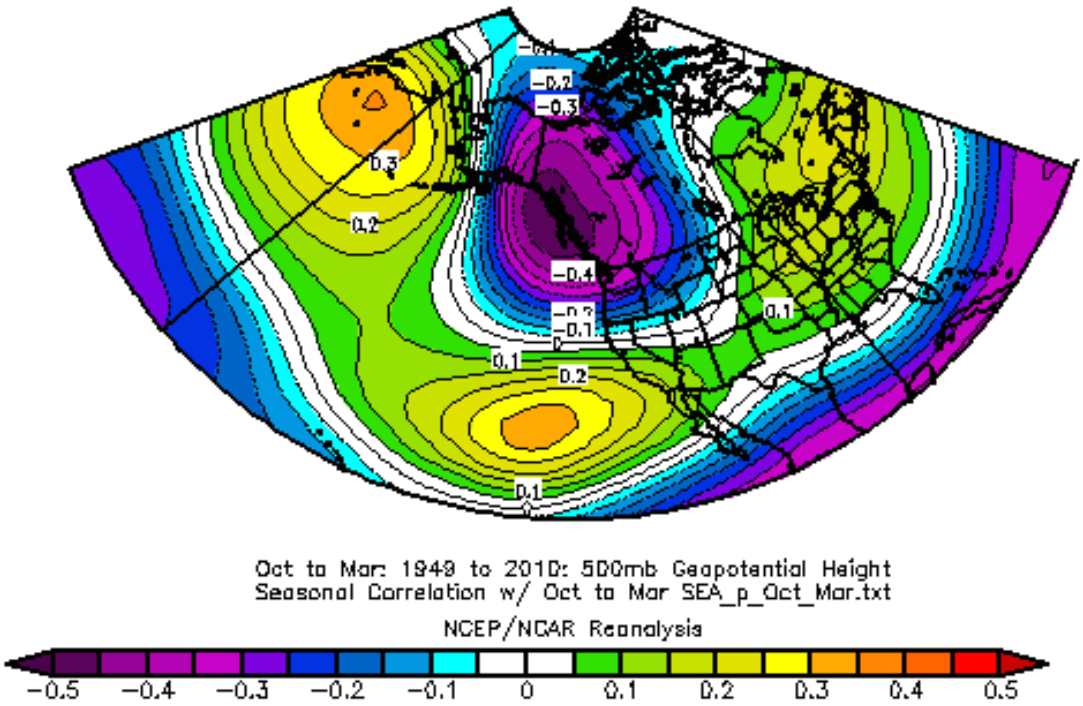


Figure 5: Distribution of correlation coefficients of 500 hPa geopotential height with total precipitation at SEA during October through March (from ESRL).

There are some interesting details in Figure 6. The driest year at SEA by a large margin was 1976-77, and this winter was also quite dry for California and especially the northern part of the state including SFO. The winter of 1997-98 was the wettest of the period considered here at both LAX and SFO. In second place at SFO was the winter of 1982-83, which happens to be the wettest for the state of California as a whole in the record extending back to 1895. Those two winters included greater than normal amounts of rainfall for SEA, and the Pacific Northwest in general (especially 1982-83). A key point is that these winters featured extremely strong El Niño events. There are too few of these extreme events to say anything definitive, but it is plausible that they have different effects on the seasonal weather of western North America than more run-of-the-mill ENSO events.

The bottom line is that indeed while there is some tendency for the winter precipitation anomalies in Washington state and at least southern California to be of the opposite sense, there have been plenty of winters with enough juicy Pacific storms to go around. Who knows, maybe this one will be one of those cases.

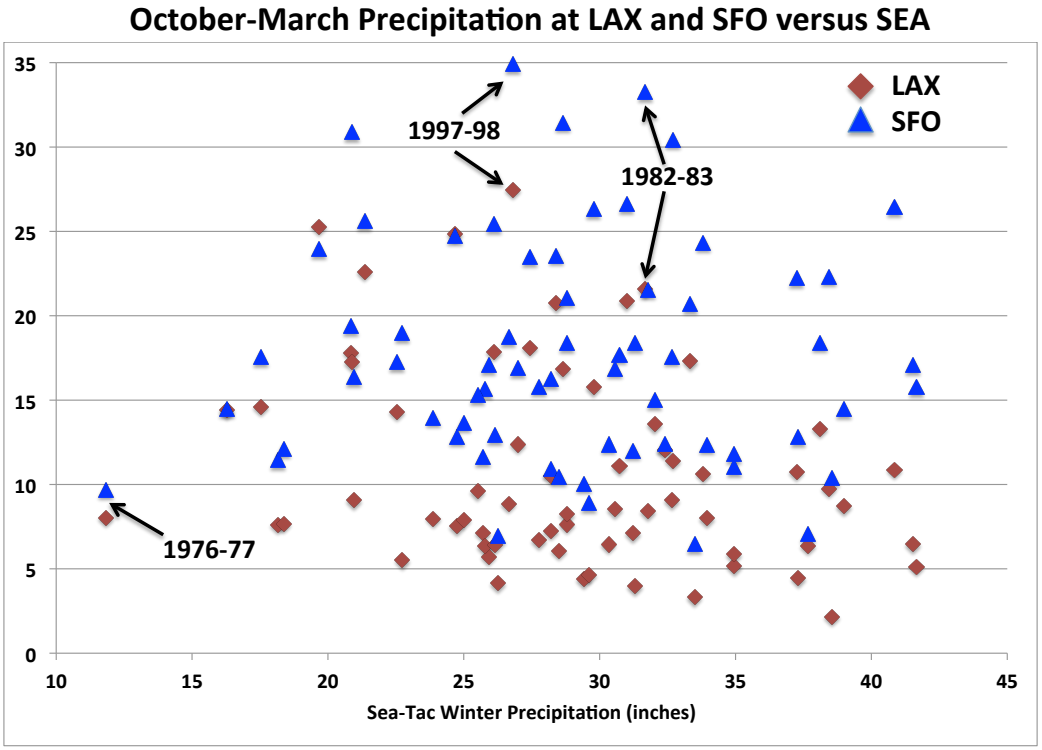


Figure 6: Scatterplot of October-March precipitation (inches) at LAX (red diamonds; y-axis) and SFO (blue triangles; y-axis) versus SEA (x-axis) for 1948-49 through 2013-14.

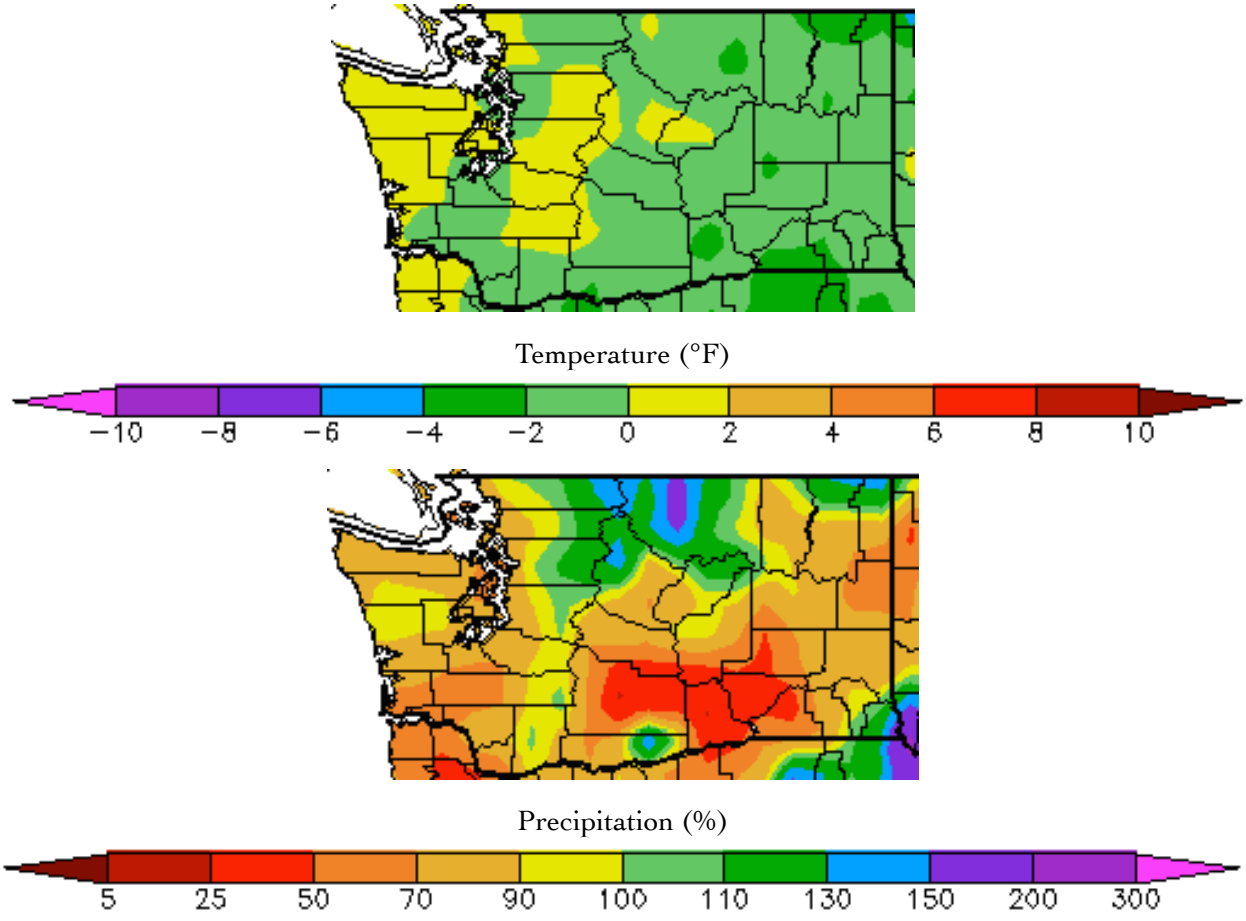
CoCoRaHS

Thank you, CoCoRaHS observers, for continuing to measure precipitation in your backyards! We've already had some snow in most of the state this winter, but now would be a great time to brush up on process for measuring snow. Measuring snow is a little more complicated than measuring rain, and it has multiple different types of observations. You can refresh with these slides: http://cocorahs.org/media/docs/measuringSnow2.1.pdf. As always, please help spread the word to friends and family. We really do appreciate all your efforts.

Climate Summary

The mean November temperatures were much closer to normal than in recent months, and tended to be on the cooler side, especially for stations east of the Cascade Mountains. The near-normal and below normal average November temperatures ended a 4-month stretch of decidedly above normal monthly average temperatures for the entire state. The map from the High Plains Regional Climate Center below shows that temperatures were within 2°F of normal for most of the state. Eastern WA was cooler, with Spokane, Omak, and Pasco 1.1, 2.5, and 2.7°F below normal, respectively (Table 1). Some other locations were much closer to normal, especially west of the Cascade Mountains where the Seattle Forecasting Office came in exactly at the 30-year normal, for example (Table 1).

Total November precipitation was below normal for most of the state, especially in the lower Columbia Basin where less than 50% of normal precipitation fell. For example, Pasco and Hanford only received 47 and 39% of normal precipitation (Table 1). Most of western WA received below normal precipitation as well, with monthly totals between about 70 and 90% of normal. The northern Cascades and Okanogan County are the exception, with normal to above normal (130%) precipitation for the month.



November temperature (°F) departure from normal (top) and November 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)			Snowfall (inches)		
	Avg	Norm	Departure from Normal	Total	Norm	% of Norm	Total	Norm	% of Norm
Western Washington									
Olympia	43.1	43.3	-0.2	6.12	8.63	71	M	0.9	-
Seattle WFO	46.2	46.2	0.0	4.41	5.84	76	T	0.3	0
SeaTac AP	46.0	45.4	0.6	4.84	6.57	74	0.8	1.2	67
Quillayute	45.2	44.2	1.0	13.18	15.52	85	M	1.4	-
Hoquiam	46.4	45.8	0.6	9.52	11.17	85	M	0.4	-
Bellingham AP	44.0	43.2	0.8	4.37	5.80	75	M	0.9	-
Vancouver AP	45.0	46.4	-1.4	2.92	5.91	49	M	M	-
Eastern Washington									
Spokane AP	34.6	35.7	-1.1	1.34	2.30	58	0.5	7.4	7
Wenatchee	38.2	37.6	0.6	0.91	1.11	82	M	5.0	-
Omak	33.4	35.9	-2.5	2.00	1.81	110	M	M	-
Pullman AP	36.5	37.0	-0.5	2.78	2.29	121	M	M	-
Ephrata	37.1	37.0	0.1	0.90	1.06	85	M	2.6	-
Pasco AP	38.6	41.3	-2.7	0.51	1.09	47	0.1	M	-
Hanford	37.8	40.5	-2.7	0.37	0.95	39	0.9	2.0	45

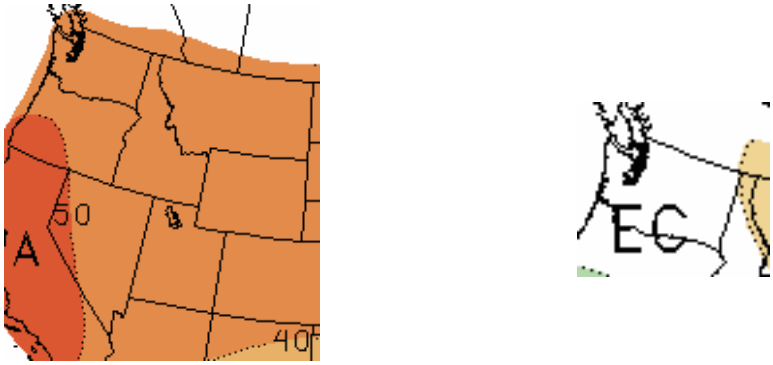
Table 1: November climate summaries for locations around Washington with a climate normal baseline of 1981-2010. Note that the Vancouver Pearson Airport and Seattle WFO 1981-2010 normals involved using surrounding stations in NCDC's new normal release, as records for these station began in 1998 and 1986, respectively. M denotes missing data.

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. The sea-surface temperatures (SSTs) averaged over both the last week and the last month are warmer than normal throughout the entire equatorial Pacific Ocean. As stated above, while the oceanic signal of an El Niño is in place, the atmosphere has been slow to respond. Models are still predicting weak El Niño development and the "El Niño Watch" that was initially released by the CPC in early March is still in effect. The latest ENSO forecast made in mid-November shows greater than a 70% chance of an El Niño this winter.

The Climate Prediction Center seasonal outlook for December is calling for increased chances of above normal temperatures statewide (and for much of the country, for that matter). There's not much indication of how December precipitation will fare as there are equal chances of below, equal to, or above normal precipitation statewide. For what it's worth, the NCEP Coupled Forecast Model (CFSv2) is showing wetter than normal conditions for much of the state during December.

The winter (December-January-February; DJF) CPC outlook reflects the more canonical El Niño pattern for the Pacific Northwest with higher chances of warmer than normal temperatures and below normal precipitation for the entire period.



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

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