Office of the Washington State Climatologist

December 2019 Report and Outlook

December 5, 2019

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November Event Summary

Mean November temperatures were near-normal throughout most of the state, with some exceptions. Notably, higher elevation locations, such as the Cascade Mountains and Olympic Mountains, were warmer than normal and the Lower Columbia Basin was colder than normal. Precipitation, on the other hand, was consistently much below normal statewide. Many locations ranked among the top ten driest Novembers on record as shown in Table 1. Also notable in Table 1, is that the record driest November for many stations occurred in 1976, which was the start of a serious drought season for all of the state. We are in no way predicting a drought of that magnitude again, but it is worth mentioning that a few of the dry November records for 2019 are on par with 1976, and that we will be monitoring our seasonal precipitation closely.

Weather-wise the month was quiet, especially considering daily records. The month generally started off with warmer than normal temperatures for the first half and colder than normal temperatures for the second half. There was a daily maximum rainfall record set at Quillayute on the 17th of 2.09", about 30% of the total monthly precipitation at the station. The 17th and the few days that followed were generally the wettest period of the month for most locations. Notably, SeaTac recorded measurable precipitation on only 9 days for November 2019; average is double that.

An isolated snow band on the afternoon of the 26th caused multiple crashes on I-90 west of Spokane, impacting 127 vehicles total (Spokesman-Review; Seattle Times). Spokane AP only recorded 0.6" of snow on that day, but snow was much heavier in the isolated band west of the city. Finally, there was some strong sustained winds and wind gusts on the 27th around the state. For example, Bellingham AP recorded a 52 mph gust, and winds were sustained at 45 mph in Puyallup and Friday Harbor, 42 mph in Chelan, 42 mph on Othello, and 30 mph in Seattle.

Station	November Total Precipitation (in)	Rank	Record (Amount; Year)	Records Began
Hoquiam	3.46”	2	2.51”; 1976	1953
Goldendale	0.08”	3	0.03”; 1936	1909*
Yakima	0.04”	3	T; 1990 & 1976	1946
Olympia	1.74”	3	1.37"; 1976	1941
Walla Walla	0.57”	3	0.50”; 1976 & 1952	1949
Wenatchee	0.11”	3	0.03”; 1976	1931
Cle Elum	0.25”	3	0.10”; 1929	1899
SeaTac AP	1.71”	4	0.74”; 1976	1945
Quillayute	6.69”	5	4.41”; 1976	1966
Bellingham AP	2.10”	6	1.37”; 1952	1949
Ephrata AP	0.13”	6 (tie)	T; 2004 & 1976	1949
Ritzville	0.36”	7	0.18”; 1939	1906

Table 1: November precipitation records for a selection of WA stations. *1972-1994 is missing from the Goldendale record.

So what has the fall as a whole looked like? Figure 1 shows the September-November temperature departures from normal and percent of normal precipitation. Fall temperatures were near-normal for most of western WA but below normal in eastern WA. Fall precipitation was generally below normal, especially in southern WA, though north central WA and some of the central Puget Sound saw above normal fall precipitation, mostly due to the wet September.

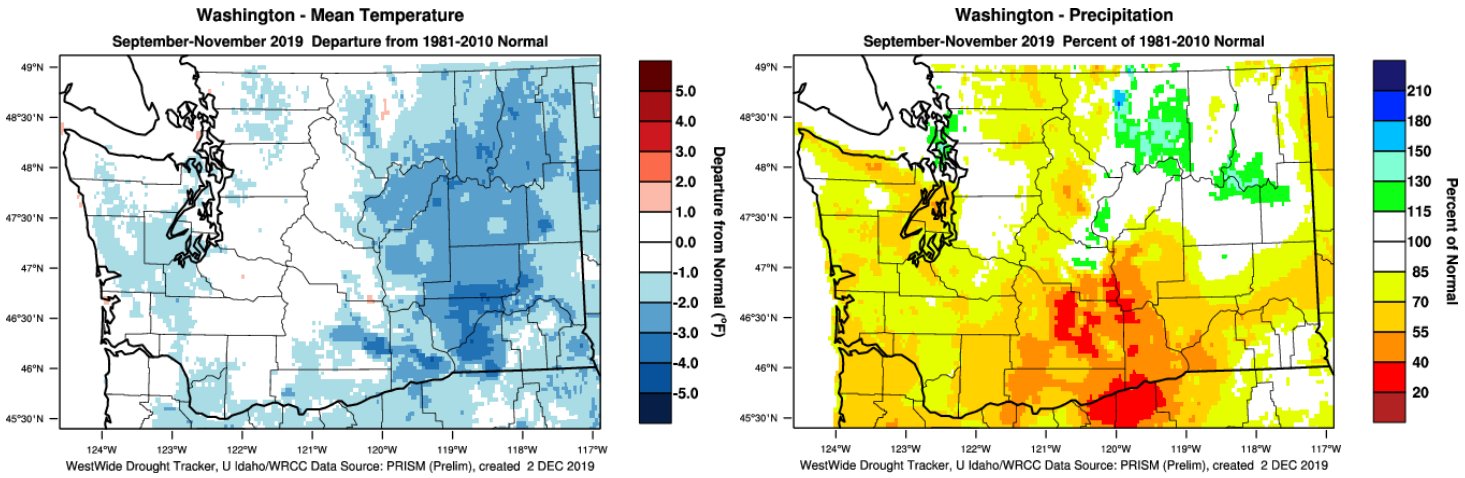


Figure 1: September-November temperature departures from normal and precipitation percent of normal. Normal baseline is 1981-2010.

Snowpack and Drought Monitor Update

Due to the dry November, there was limited mountain snow during the month. The basin average snow water equivalent (SWE) percent of normal from the Natural Resources Conservation Service (NRCS) as of December 1 is shown in Figure 2. The percentages of normal SWE, like November precipitation, are all below 50% of normal. The Olympic Mountains are in particularly bad shape, with only 18% of normal. With that said, we are still very early in the snowpack-building season, so it is not yet time to panic. On the other hand, the U.S. Drought Monitor (Figure 3) recently added an "abnormally dry" designation (D0 on a D0 to D4 scale) throughout most of the state. Even considering the record wet September, the fall has been dry overall, and the streamflows, particularly in western WA, are once again much below normal.

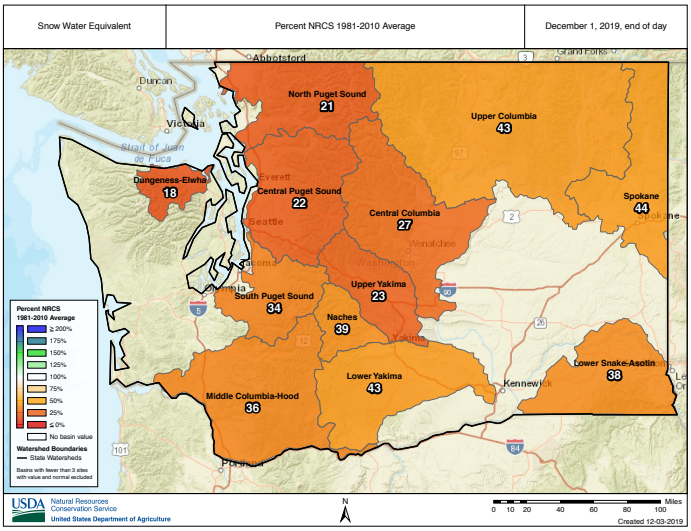


Figure 2: Snowpack (in terms of snow water equivalent) percent of normal for Washington as of December 1, 2019 (from NRCS).

Report Your Drought Impacts

Are you experiencing a drought impact? Your on-the-ground observations are critical in helping us understand the broad picture of drought in the state. The National Drought Mitigation Center has developed a Drought Impact Reporter that allows the public to enter their observations regarding crops, water supply, fire, etc. in a short survey and we would appreciate your input.

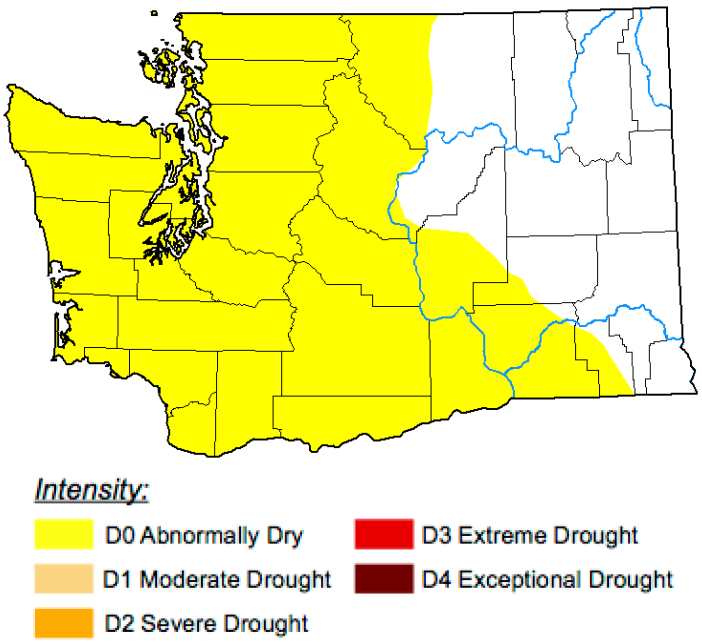


Figure 3: The 5 December 2019 edition of the U.S. Drought Monitor.

Localized Variations in Winter Minimum Temperatures

A message from the State Climatologist

Recent cold overnight temperatures during Thanksgiving weekend 2019 have illustrated the variability from place to place that can emerge this time of year. There are many locations in WA state in which observing stations are not that far apart, but minimum temperatures vary substantially, particularly on clear, cold nights. In this piece, we use just one example in the central Puget Sound region: Everett Snohomish County Airport, i.e., Paine Field, and Arlington. The Everett station is about 21.5 miles south-southwest of Arlington, as the crow flies (Figure 4).

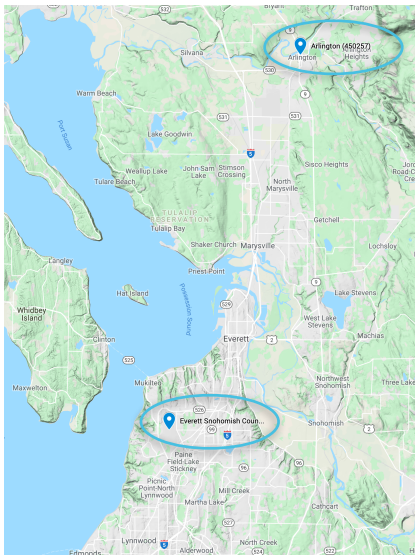


Figure 4: A zoomed in map of the central Puget Sound, showing the locations of the Everett and Arlington stations (blue markers).

We focus on the December and January days for Arlington (450257) and Everett Snohomish County Airport (452670; hereafter just "Everett"). Due to missing data for each station, we use the period of overlap, 2006-2018, which is a relatively short 13-year record. Nevertheless, since a total of 806 December and January days are considered, the relationship between the stations is considered robust. Importantly, Everett is at 606' elevation while Arlington is at 100'.

Figure 5 shows two scatterplots – one for maximum temperatures (Tmax) and one for minimum temperatures (Tmin) – with each marker representing one day. Tmaxs (Figure 5a) generally have a 1:1 relationship between the two stations. Arlington does tend to be a degree warmer on these winter days, on average, though it certainly isn't always the case. The correlation coefficient for Tmax is 0.90 showing a fairly strong correspondence. Tmins (Figure 5b), on the other hand, are generally warmer in Everett compared to Arlington. On average, Everett Tmins are 6°F warmer than Arlington. The correlation coefficient is significantly lower for min temps at about 0.83.

So why the difference? The Everett station is located on an isolated plateau that tends to stay warmer overnight compared to Arlington's location in a valley where the coldest air settles. In addition, the former is situated only about 2 miles from Puget Sound, while Arlington is about 10 miles away from that moderating influence. We also see a marked difference in Tmins between Tacoma and SeaTac AP, with SeaTac's plateau location also resulting in warmer temperatures on clear nights with prominent radiational cooling. On the other hand, there are some stations spaced close together, such as Spokane Felts Field and Spokane International AP in which we don't see much difference in either Tmaxs or Tmins. A crow needs to fly only 10.5 miles from one station to the other, with the city of Spokane in between. The correlations between daily December and January values of Tmax and Tmin are 0.96 and 0.97, respectively, with a much greater 1:1

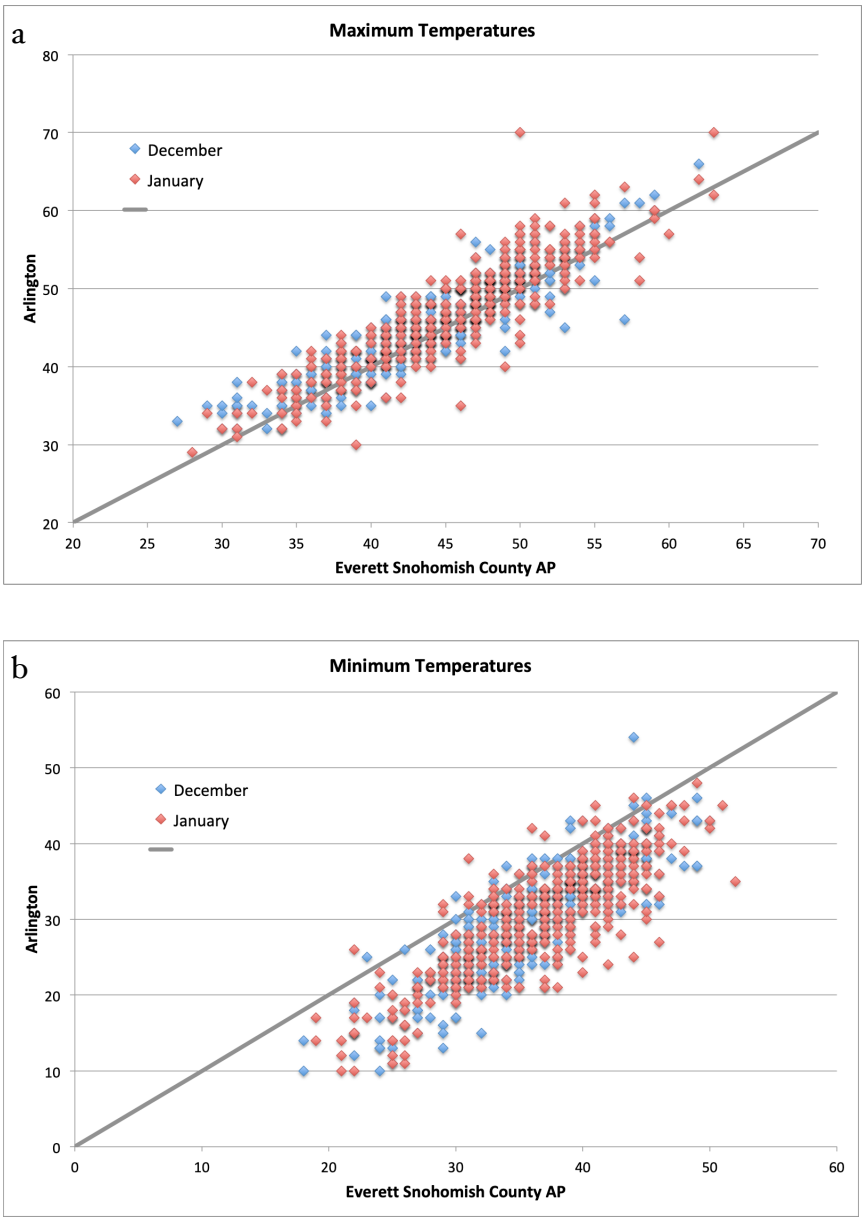


Figure 5: December and January 2006-2018 (a) maximum temperatures (Tmax) and (b) minimum temperatures (Tmin) for Arlington vs. Everett compared to a 1:1 relationship (gray line).

correspondence between the stations (not shown). While Spokane International AP is at an elevation 420 feet higher than that of Felts Field, it is situated on a broad plain rather than an isolated plateau, and so the cold air that forms near the ground has nowhere to go. Felts Field is also in close proximity to the Spokane River, and perhaps that helps moderate temperatures during cold winter nights.

A specific example of a recent clear, cold night in western WA is shown the air temperature map for 7 am on Dec 5, 2018 (Fig 6). The Everett station is in the 23-32°F band, while Arlington is located in the 14-23°F band. The Tmin on the 5th was 29°F and 15°F for Everett and Arlington, respectively, quite a large difference for stations relatively close. Note the other cool spots that emerge on the map, such as south of Olympia, showing the substantial differences in Tmins that can develop on clear winter nights. The lower foothills of the western slope of the Cascades also tended to be warm in this example, as is typically the case, due to drainage of the cold-air that develops near the surface.

Numerical weather prediction (NWP) models struggle to reproduce the surface-based temperature inversions that occur during clear, calm winter nights, and hence the corresponding spatial variations in surface temperatures. But since these variations are so closely tied to the local terrain and land-water differences, they are systematic. In other words, you probably already know if you live in a warm versus a cold spot.

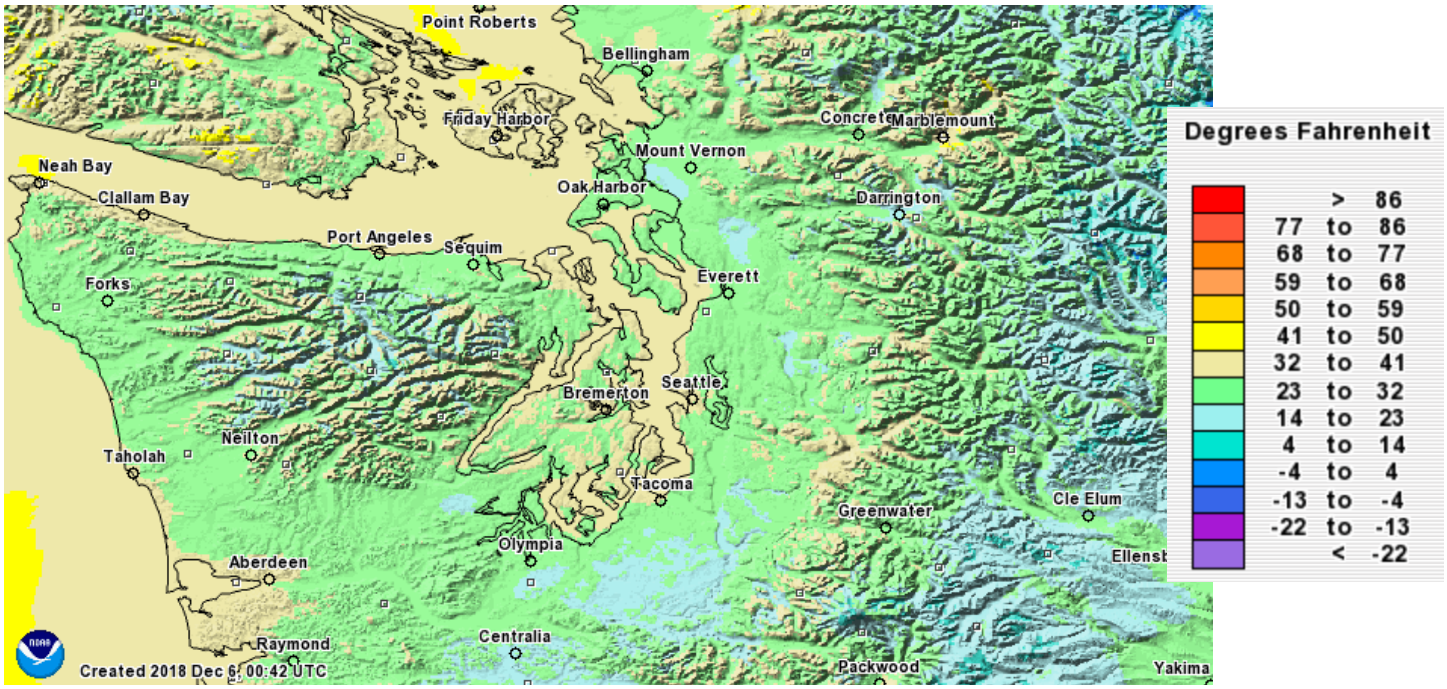
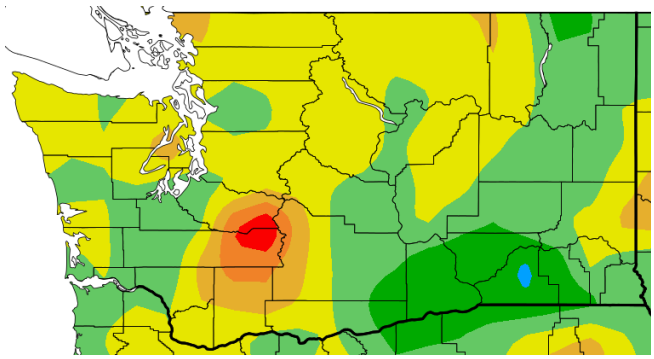


Figure 6: Modeled surface air temperatures from NOAA's Operational Hydrologic Remote Sensing Center from 7 am PST on December 5, 2018.

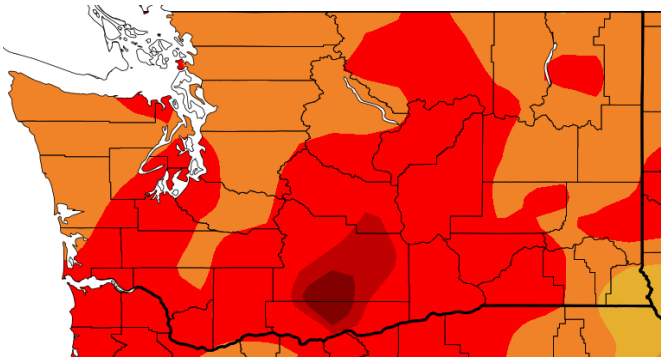
Climate Summary

Mean November temperatures were near-normal for most of WA state. For example, the Seattle Weather Forecasting Office, Quillayute, Hoquiam, and Spokane Airport were all within 0.2°F of normal (Table 2). There were some regions with more substantial anomalies, however. Though it only shows up in the southern Cascades on the plot on the right-hand-side, most of the Cascade and Olympic Mountains were 3-6°F above normal for the month (the map on the right does not include many high elevation stations). The other larger anomaly is in the Lower Columbia Basin, where November temperatures were between 2 and 3°F below normal. Pasco and Hanford were cool spots, with temperatures 3.0 and 2.4°F below normal, respectively (Table 2).

Total November precipitation was much below normal statewide, with a large area of the state only receiving between 5 and 25% of normal precipitation. For the wettest month of the year climatologically, these anomalies are sizable. Olympia, for example, only received 20% of normal precipitation, with Wenatchee and Ephrata receiving 10 and 12% of normal, respectively. Some areas fared slightly better but still received less than half of normal November precipitation. Quillayute and Bellingham received 43 and 36% of normal, respectively, the highest percentages of normal reported in Table 2. Lowland snow was also lacking for November, with just minimal amounts measured in eastern WA.



Temperature (°F)



Precipitation (%)

November 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)			Snowfall (inches)		
	Avg	Norm	Departure from Normal	Total	Norm	% of Norm	Total	Norm	% of Norm
Western Washington									
Olympia	42.0	43.3	-1.3	1.74	8.63	20	0.0	0.9	0
Seattle WFO	46.4	46.2	0.2	1.77	5.84	30	0.0	0.3	0
SeaTac AP	46.6	45.4	1.2	1.71	6.57	26	0.0	1.2	0
Quillayute	44.4	44.2	0.2	6.69	15.52	43	0.0	1.4	0
Hoquiam	46.0	45.8	0.2	3.46	11.17	31	0.0	0.4	0
Bellingham AP	45.5	43.2	2.3	2.10	5.80	36	0.0	0.9	0
Vancouver AP	45.7	46.4	-0.7	1.57	5.91	27	M	M	-
Eastern Washington									
Spokane AP	35.6	35.7	-0.1	0.68	2.30	30	0.6	7.4	8
Wenatchee	36.5	37.6	-1.1	0.11	1.11	10	M	M	-
Omak	36.4	35.9	0.5	0.28	1.61	17	M	M	-
Pullman AP	38.3	37.0	1.3	0.44	2.29	19	M	M	-
Ephrata	38.1	37.0	1.1	0.13	1.06	12	M	M	-
Pasco AP	38.3	41.3	-3.0	0.18	1.09	17	M	M	-
Hanford	38.1	40.5	-2.4	0.09	0.95	9	T	1.7	0

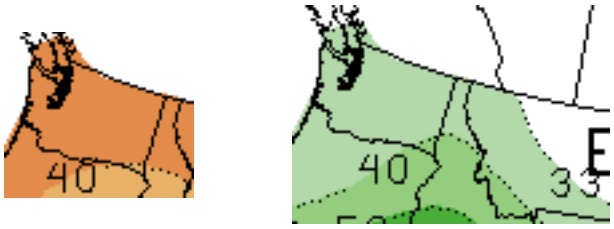
Table 2: November 2019 climate summaries for locations around Washington with a climate normal baseline of 1981-2010. Note that the Vancouver Pearson Airport and Seattle WFO 1981-2010 normals involved using surrounding stations in estimating the normal, as records for these station began in 1998 and 1986, respectively.

Climate Outlook

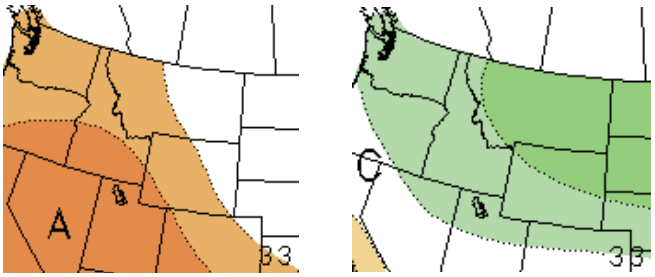
According to the Climate Prediction Center (CPC), neutral ENSO conditions are present in the equatorial Pacific. Over the last month, sea surface temperatures (SSTs) have remained above normal in the equatorial Pacific Ocean with anomalies increasing in the eastern Pacific and decreasing in the western and central Pacific. ENSO forecast models show a continuation of ENSO-neutral conditions through the winter and spring. For the January-February-March period, there is a 66% chance of neutral conditions compared to much lower chance of El Niño (24%) or La Niña (10%) development.

The CPC December temperature and precipitation outlook calls for increased chances of above normal temperatures and increased chances of above normal precipitation statewide.

The CPC winter (December-January-February; DJF) seasonal temperature outlook is also showing higher chances of above normal temperatures statewide. Similar to the December outlook, there are higher chances of above normal precipitation for the entire state. The higher odds of wetter than usual conditions is new in this forecast; earlier forecasts for the upcoming winter included equal chances of either below, equal to, or above normal precipitation.



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



December-January-February outlook for temperature (left) and precipitation (right)

(Climate Prediction Center)