



Office of the Washington State Climatologist

December 2017 Report and Outlook

December 5, 2017

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

November Event Summary

Mean November temperatures were near-normal throughout most of the state, with the exception of a few locations in eastern and southeastern WA where temperatures were above normal.

Precipitation was above normal across nearly the entire state.

The near-normal monthly temperatures hide the prominent fluctuations in temperatures that occurred in November. This is shown in Figure 1 for SeaTac Airport, but true for the entire state. The beginning of the month was marked by much cooler than normal temperatures while there was a period of warmer than normal temperatures at the end of the month.

The cool period in early November was a classic set up for lowland snow - a large trough bringing cool air from the north with precipitation in the mix - and likely would have been a bigger event had it have occurred later in the winter. Still, lowland snow was measured in parts of the state from the 2nd through the 5th. The 24-hr snowfall observations from CoCoRaHS observers ending on the morning of Nov 5th are shown in Figure 2. The Port Angeles area saw the most snow in western WA, with several observations between 2

In this Issue

- November Event Summary.....1
- Snowpack Update.....3
- CoCoRaHS Note.....3
- On the Timing of Winter.....4
- Climate Summary6
- Climate Outlook8

and 5” on the morning of the 5th. Two inches of snow was common throughout eastern WA for this particular event. At Spokane Airport, 3.2” of

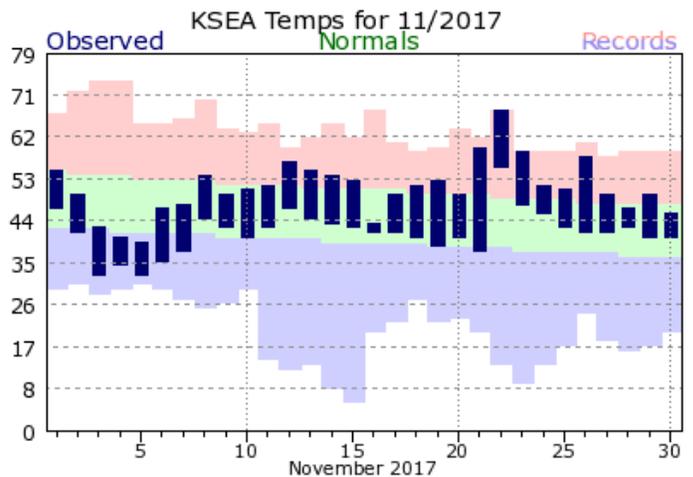


Figure 1: Daily November 2017 temperatures (dark blue bars) for SeaTac Airport and historical records (red and blue bars). [NWS](#)

snow was measured on the 5th, marking a calendar day record there.

On the flip side, there was a period with remarkably high temperatures for November towards the end of the month. Precipitation was associated with this as well, but this time in the form of rain. On the 21st, Quillayute set a maximum daily rainfall record (2.54") as warm, moist air moved into the region. Record high daily temperatures were set at Bellingham (68°F), SeaTac Airport (68°F), Olympia (68°F), Yakima (69°F - tie), and Quillayute (58°F) on the 22nd, as temperatures were well into the 60s west of the Cascade Mountains and in the 50s east of the crest. Nighttime temperatures were also balmy for the time for year.

Along with the swings in temperature, November was consistently wet with several instances of high winds as well. Snow in the mountains was relatively plentiful, with many ski operations opening several lifts during the month.

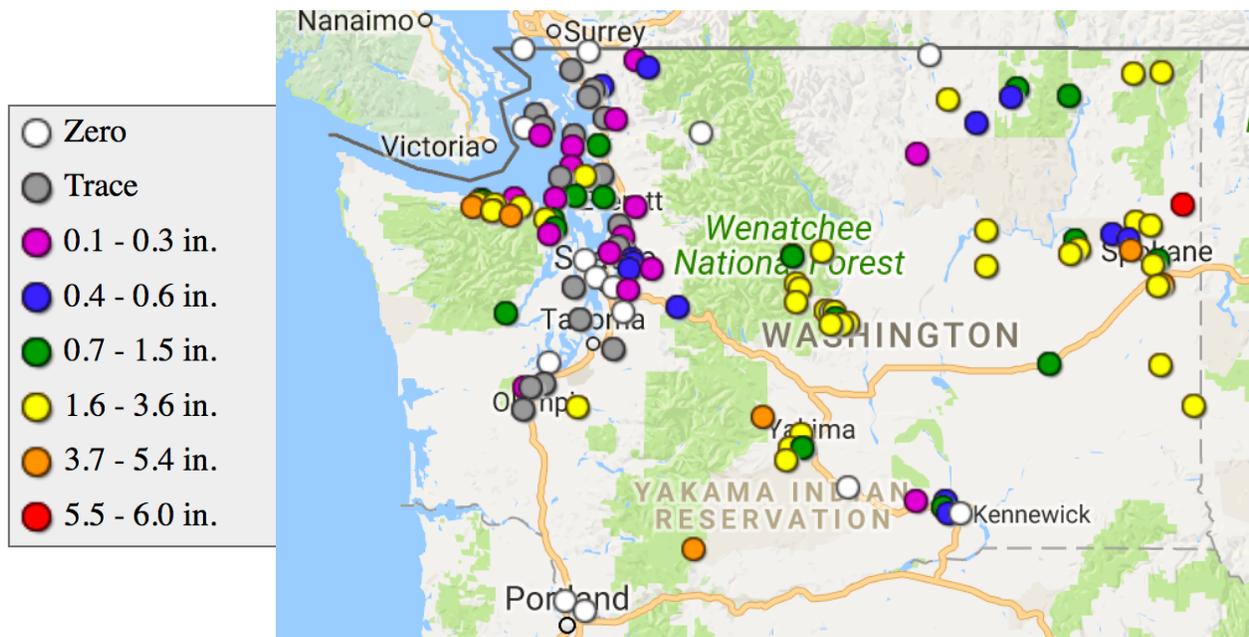


Figure 2: 24-hr snowfall observations on the morning of November 5 from [CoCoRaHS](#) observers.

Snowpack Update

The above average fall precipitation has erased the drought conditions that had developed over the summer. The US Drought Monitor shows drought-free conditions throughout the entire state. The above average precipitation has led to abnormally wet soil moisture throughout the state as well. The basin average snow water equivalent (SWE) percent of normal from the National Resources Conservation Service is shown in Figure 3. As of December 4, the Olympic, North Puget Sound, Upper Columbia, and Lower Columbia basins all show above normal SWE (116-229% of normal). The Central Puget Sound, South Puget Sound, Upper Yakima, and Lower Yakima basins are also looking good with near normal average basin SWE between 92 and 106% of normal. On the other hand, the Central Columbia, Spokane, and Lower Snake basins are on the lower side, with SWE between 74 and 86% of normal. We will continue to monitor the SWE in the mountains, particularly because of the extended dry spell forecast for the first half of December.



photo by Henry Reges, CoCoRaHS

Community, Collaborative Rain, Hail, and Snow (CoCoRaHS) Network

Are you interested in measuring rain and snow in your backyard? Observations provided by volunteers are extremely important to us, particularly snowfall observations since many of the official weather stations do not report snow. As shown in our opening, we use these reports to help verify the weather forecasts and inform our climate summaries.

If you're interested, please visit www.cocorahs.org to sign up, and let us know if we can answer any questions.

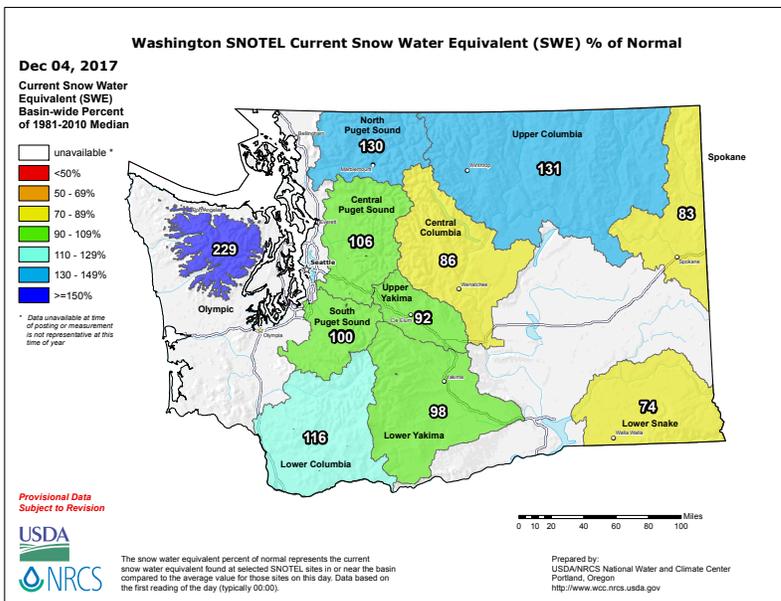


Figure 3: The 4 December 2017 edition of the US Drought Monitor.

Is Winter Coming Later to Washington State?

A message from the State Climatologist

The Office of the Washington State Climatologist sometimes receives questions about whether the timing of the seasons has shifted. Ken Kunkel and collaborators have examined how the length of the growing season has changed [across the lower 48 states](#), and others have documented the changes from a regional perspective (e.g., Abatzoglou et al., 2014 and the [Climate Impacts Group](#)). Here we will provide a modest contribution to this body of work, focusing on the winter season and including consideration of the variability at individual locations.

As is the typical practice, we key on the date of the first freeze, i.e., a minimum temperature less than or equal to 32°F. We use the daily minimum temperatures from a number of west side and east side stations for two reasons: (1) minimum temperatures, especially in clear and calm conditions, can vary so much from place to place, and (2) *dates* of weather events represent inherently noisy time series. We also selected stations away from the large urban areas of central Puget Sound and eastern Washington (Seattle and Spokane - you are off the hook this time). Our analysis spans the period from the late 1940s, when many of the present weather stations across WA state were established, through 2017.

Time series of the first freeze dates for the west side stations of Hoquiam, Longview, Olympia, Olga (southern Orcas Island), and

Bellingham are shown in Figure 4. Time series for the east side stations of Richland, Walla Walla, Cle Elum, Ritzville, Chelan, and Newport are shown in Figure 5. Not surprisingly, there are systematic differences in timing among the two groups of stations. For example, of the western group, Olympia generally gets an early frost and Olga tends to be late, and of the eastern group, Cle Elum on the east slope of the Cascade Mountains is early and Walla Walla is late. During some years there appears to be a cold snap such that most stations get their first hard frost within a few days of one another, and there are other years with more than a couple of months of separation between the first freezes at different locations.

Linear fits to these noisy time series have been made to quantify overall trends. For the west side stations, the average date of the first freeze at the end of the record is about 7-9 days later than at the beginning of the record, depending on whether one averages individual trends versus averaging the mean date for the 5 stations. The two stations with greater marine influences of Hoquiam and Olga exhibit relatively small and negligible trends, respectively. For the six eastern WA stations, the first freeze is now occurring about 14 days later. It is recognized that the period of 1948 to 1951 was relatively cold, especially on west side of Cascades, and that computations of trends are sensitive to values near the beginning and the end of records.

Therefore, we also computed linear trends with a starting year of 1952, which yielded the results of a bit smaller delays on the west side and not much differences in the overall trends for the east side.

The larger shift in the timing of the first freeze for the east side is consistent with the overall changes in mean minimum temperatures over the period of 1948-2017, which have risen about 1.5°F in the Puget Sound climate division for the months of October and November combined, and about 2°F in the Central Basin climate division for the months of September and October. We are unsure how much these changes may have already impacted the landscape. Presumably there are effects ranging from the color of fall foliage to the timing of wine grape harvests, and that they will become increasingly prominent in future decades.

Reference:

Abatzoglou, J. T., D. E. Rupp, and P. W. Mote, 2014: Seasonal climate variability and change in the Pacific Northwest of the United States. *J. Climate*, **27**, 2125-2142, doi:<https://doi.org/10.1175/JCLI-D-13-00218.1>.

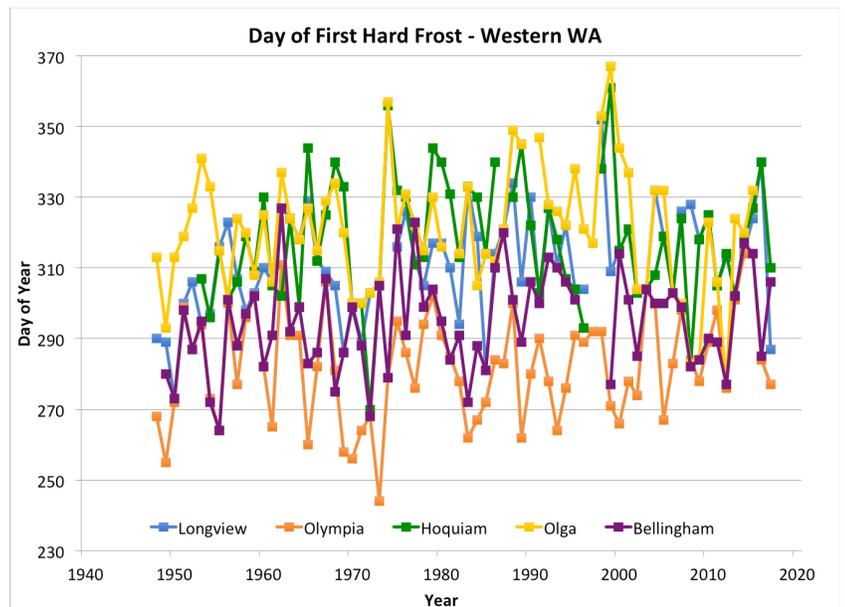


Figure 4: Day of year of the first freezes (daily minimum temperatures less than or equal to 32°F) for the western WA locations of Hoquiam, Longview, Olympia, Olga, and Bellingham.

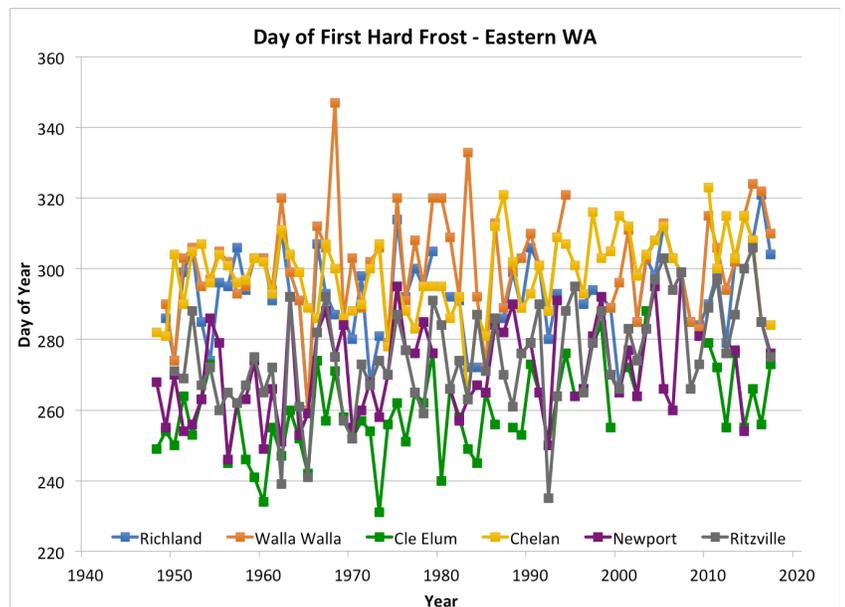
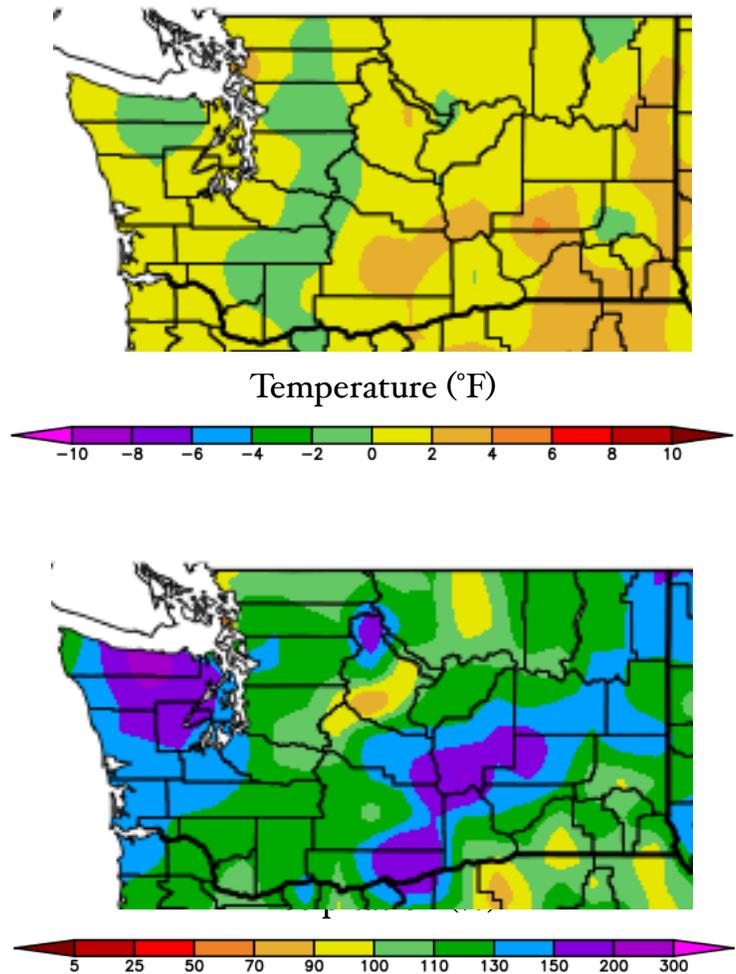


Figure 5: Day of year of the first freezes (daily minimum temperatures less than or equal to 32°F) for the eastern WA locations of Richland, Walla Walla, Cle Elum, Ritzville, Chelan, and Newport.

Climate Summary

Mean November temperatures were near normal for most of the state. Olympia, Vancouver, and Wenatchee, for example, had mean monthly temperature anomalies that were 0.4, 0.8, and 0.3°F above or below normal (Table 1). There were some exceptions, of course, and southeastern WA tended to be on the warm side, according to the map from the High Plains Regional Climate Center. Pullman and Spokane were especially warm relative to normal, with a 3.1°F and 2.0°F monthly temperature anomaly, respectively (Table 1).

Total November precipitation was above normal for nearly the entire state, particularly on the Olympic Peninsula where precipitation was between 130 and 200% of normal. Hoquiam, for example, received 147% of normal precipitation for the month (Table 1). But the rest of the state was wetter than usual as well, with SeaTac AP, Wenatchee, and Ephrata receiving 131, 126, and 134% of normal precipitation, respectively.



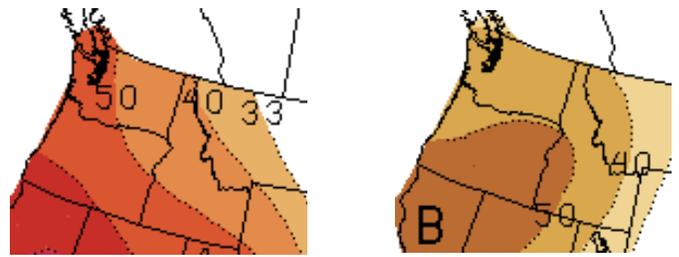
November temperature (°F) departure from normal (top) and precipitation percent of normal (bottom). (High Plains Regional Climate Center; relative to the 1981-2010 normal).

	Mean Temperature (°F)			Precipitation (inches)			Snowfall (inches)		
	Avg	Norm	Departure from Normal	Total	Norm	% of Norm	Total	Norm	% of Norm
Western Washington									
Olympia	43.7	43.3	0.4	12.28	8.63	142	M	0.9	-
Seattle WFO	46.6	46.2	0.4	8.32	5.84	142	T	0.3	0
SeaTac AP	46.7	45.4	1.3	8.63	6.57	131	0.4	1.2	33
Quillayute	45.2	44.2	1.0	19.91	15.52	128	M	1.4	-
Hoquiam	46.6	45.8	0.8	16.47	11.17	147	0	0.4	0
Bellingham AP	45.3	43.2	2.1	6.21	5.80	107	M	0.9	-
Vancouver AP	47.2	46.4	0.8	6.50	5.91	110	M	M	-
Eastern Washington									
Spokane AP	37.7	35.7	2.0	2.88	2.30	125	7.2	7.4	97
Wenatchee	37.3	37.6	-0.3	1.40	1.11	126	M	M	-
Omak	36.7	35.9	0.8	1.55	1.61	96	M	M	-
Pullman AP	40.1	37.0	3.1	3.02	2.29	132	M	M	-
Ephrata	38.7	37.0	1.7	1.42	1.06	134	M	M	-
Pasco AP	42.5	41.3	1.2	1.17	1.09	107	T	M	-
Hanford	40.1	40.5	-0.4	1.45	0.95	153	3.3	2.0	165

Table 1: November 2017 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.

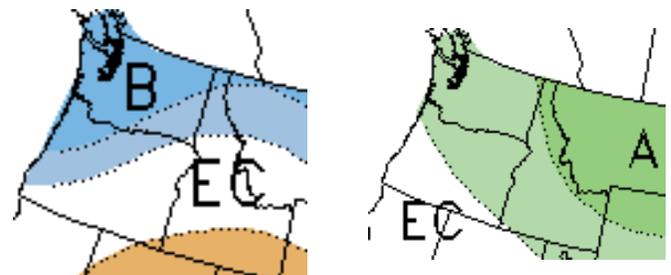
Climate Outlook

According to the Climate Prediction Center (CPC), weak La Niña conditions are present in the equatorial Pacific Ocean. Sea-surface temperatures (SSTs) have been below normal throughout the region, and have been that way for several weeks. In addition, the atmosphere is displaying characteristic signals of La Niña. A “La Niña Advisory” was issued by the CPC on November 9. There is over a 70% chance that La Niña will persist through the winter and the winter CPC outlook below reflects that.



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

The CPC seasonal outlook for December is calling for increased chances of above normal temperatures across the entire state. The likelihood of warmer than normal temperatures is higher for western WA compared to that in eastern WA, but above normal temperatures are likely for the entire state. For December precipitation, the odds are tilted toward below normal precipitation for the entire state.



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

The winter (December-January-February; DJF) CPC outlook is quite different from the December expectations for WA State. Winter temperatures, on average, are anticipated to be colder than normal for the entire state. For precipitation, wetter than normal conditions are expected. The December outlook’s contrast to the DJF seasonal outlook is a good reminder of the intraseasonal variability that can still be expected even when a cooler and perhaps wetter than usual winter is probable due to La Niña conditions.

(Climate Prediction Center)