Office of the Washington State Climatologist

January 5, 2012

December Event Summary

Mean temperatures were cooler than normal for much of the state during December. While there were some exceptions regarding average temperatures (more information in the Climate Summary below), precipitation was consistently below normal for the entire state. In fact, December 2011 ranked among the top ten driest Decembers for many locations in WA. Table 1 highlights a few of these statistics, notably Kennewick (0.08") and Richland (0.19") which ranked as the driest December dating back to 1950. The Seattle Weather Forecasting Office (WFO) also ranked as the driest December (1.49") on record, but measurements only began there in 1986.

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Station	December 2011	Average December	Rank
Kennewick	0.08	1.13	1
Richland	0.19	1.12	1
Seattle WFO	1.49	5.43	1
Bellingham	2.12	4.22	3
SeaTac	2.24	5.35	4
Vancouver 4NNE	2.74	6.40	4
Quillayute	7.90	12.99	5
Spokane AP	1.01	2.30	6
Omak	0.52	2.54	6
Ephrata	0.21	1.24	6
Yakima	0.34	1.53	8

Table 1: Total December 2011 precipitation for several WA locations, along with the 1981-2010 average December precipitation, and the ranking among the driest Decembers since 1950. Note that measurements only began in 1986 at Seattle WFO.

A large and strong ridge of high pressure formed off the coast of the Pacific Northwest at the end of November. This was a perfect set-up not just for dry conditions, but also light winds and low-level temperature inversions trapping pollutants at the surface. This persistent weather pattern prompted numerous air stagnation advisories throughout the state and lasted for over 3 weeks. Fog was common throughout this time period, as well as cool temperatures, with some instances of freezing fog (especially in eastern WA). Several

weak shortwave systems impacted the region during this time, bringing light rain or snow, but not enough to disrupt the stubborn ridge.

A change in the weather pattern finally came on Christmas Day, as a series of several fast-moving systems moved through the state, bringing precipitation and stronger winds at times. Minor flooding occurred throughout western WA and substantial snow finally fell in the mountains at the conclusion of the month.

Snowpack

The drier than normal December brought relatively meager contributions to the snowpack throughout the state. The snowpack was above normal at the beginning of December, however, and heavy snow at the end of the month in the northern Cascades helped build more snowpack in that area. The snow water equivalent (SWE) percent of normal as of January 2 from the National Resources Conservation Service is shown in Figure 1. The North Puget Sound and Central Puget Sound Basins are in good shape in terms of snowpack, with 95 and 97%, respectively. The Lower Columbia Basin is in the worst shape of the WA basins with only 65% of normal SWE at the time of this writing. The remainder of the state has between 73 and 89% of normal SWE. There is still plenty of winter left to boost these numbers, and this is something OWSC will be monitoring in the coming months.

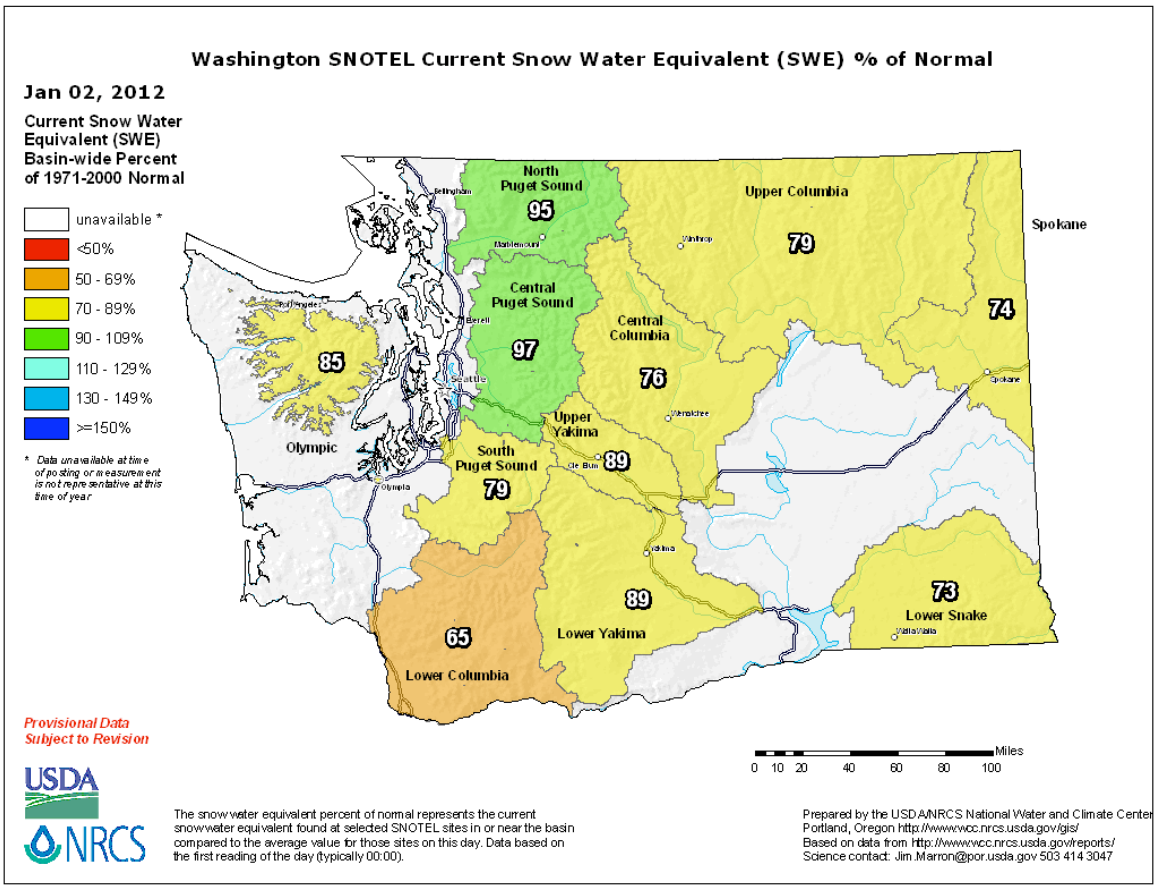


Figure 1: Snowpack (in terms of snow water equivalent) percent of normal for Washington as of January 2, 2012. Image is from the National Resources Conservation Service.

January 1950: A remarkable month for the Pacific Northwest

A message from the State Climatologist

The month of January 1950 is legendary in terms of the weather in the northwestern US. It is the coldest month on record for Washington State, with the mean of 14.5°F amounting to almost 16°F colder than the average January for the period of 1910 through 2009. A host of all-time minimum temperature records were set, especially on the west side of the Cascade Mountains. The 62nd anniversary of this month (OK, so it is not divisible by 10) is upon us and the readers of this newsletter might be interested in re-visiting this spectacular event. This brief analysis is also motivated by a recent review of the weather of January 1950 carried out by Professor Mike Wallace of the Department of Atmospheric Sciences at the University of Washington. Mark Albright of the Department of Atmospheric Sciences had the good sense to keep some newspaper clippings from this month saved by his parents; we draw upon those here. We will first consider the month as a whole including the atmospheric flow aloft, provide some details on the individual storms and cold-air outbreaks that occurred, and conclude with some comparisons with other extreme months in the record.

A map of the temperature anomalies during January 1950 for the lower 48 states of the US is shown in Fig. 2. The western US was in the deep freeze, with peak mean temperature anomalies of more than 25°F below normal in north-central Montana. As is often the case, these extremes were accompanied by anomalies of the opposite sign in the eastern US. Portions of the Deep South experienced positive anomalies as large as about 15°F. These temperature anomalies were associated with the distribution of anomalous 500 hPa geopotential height shown in Fig. 3. A deep trough extended from the Pacific states into central Canada, with peak 500 hPa height anomalies exceeding 250 m in southeastern British Columbia. Of even higher amplitude was the anomalous ridge to the west, with peak values exceeding 350 m over the southeastern Bering Sea. These are enormous signals. For the two regions, those anomalies are of amplitudes greater than 3 standard deviations, and the largest on record for January over the period of the NCEP/NCAR Reanalysis (1948-present). The 500 hPa height pattern implies anomalous flow out of western Canada into the western part of Washington. This might be assumed to lead to abnormally light precipitation but in actuality, precipitation amounts were near normal (not shown) due to considerable storminess, as discussed below. As a bit of an aside, the portion of the US that experienced the most unusual precipitation during the month was the central Midwest. Precipitation surpluses as great as 10" above normal occurred in the lower Ohio River valley in association with the anomalous southwesterly flow on the east side of the aforementioned 500 hPa trough.

Monthly means tell part of the story, but the impacts of weather on society are usually associated with individual events, and January 1950 was certainly no exception. For purposes of illustration, time series of daily mean temperatures for Spokane Airport (GEG) and SeaTac Airport (SEA) are shown in Fig. 4. The month started out on the chilly side, with some significant snowfall, especially in the western half of the state, but that was just an appetizer. After more moderate temperatures during the second week of month, but still considerable snowfall in the eastern portion of the state, a noteworthy storm slammed the Pacific

Northwest. This storm brought heavy snowfall, fierce winds and bitterly cold temperatures. Seattle received 20" of snow on the 13th, its second greatest daily amount on record. The temperatures plummeted to below zero °F that day in Spokane, and the Airport received 8" of snow. The liquid equivalent of Spokane's snowfall that day was 0.44", which is an amazingly high amount out of such a cold air mass. This situation was caused by the combination of high sea level pressure over British Columbia, a necessary condition for arctic-air outbreaks in WA, and a low off the mouth of the Columbia River with a trough extending eastward into western Montana. This set-up caused Whatcom County to hit the full trifecta of winter weather. According to the Bellingham Herald, winds of up to 75 MPH caused snow drifts as high as 10-14 feet followed by temperatures below 0°F. This newspaper also reported some good news on the 13th for which the weather must have been a proximal cause: "City police received not one complaint of unlawful activity during the morning hours." (Copies of the scanned January 1950 articles from the Bellingham Herald can be found at this link: http://www.atmos.washington.edu/marka/bham_herald_jan50.cgi). The storm that occurred mid-month would have been enough for January 1950 to be long remembered, but there was plenty more severe weather. Specifically, after a relatively mild spell from the 20th through the 24th, yet another cold blast hit the state. While not quite as prolific a snow-maker, Seattle and Spokane checked in with 10" and 6", respectively, for daily totals on the 26th. This event was characterized by particularly low temperatures in its wake, with SEA down to its all-time minimum temperature of 0°F and GEG reaching its 2nd coldest minimum of -24°F. All this is the stuff of fantasy for many meteorologists, and nightmares for emergency managers.

The abnormally cold weather of January 1950 begs the question, just how unusual was it? After all, extremely unlikely events are not just possible but rather should be expected to occur every once in a while. Towards addressing this question, a time series of the mean temperatures in Washington State during the Januarys of 1910 through 2009 are shown in Fig. 5. This time series has some interesting properties. The record cold of January 1950 is almost matched by that in 1930, 1937 and 1949. The distribution is highly skewed, with fewer but more intense cold months and more frequent but less extreme warm anomalies. It appears that the warmest it can get for the month as a whole is about 7°F above normal. Our warmest air in winter is during southwesterly flow off the Pacific Ocean, and months with a preponderance of these conditions will be warmer on the whole. This may produce an effective ceiling on our temperatures because the underlying sea surface temperature (SST) in this source region does not vary that much from year-to year, while continental regions tend to experience much greater fluctuations in temperature. It is also interesting that while any sort of systematic trend in the temperature is minimal, especially over the last few decades, there also has not been an extremely cold January since 1979. Finally, it bears noting that 1949-50 was a La Niña winter. The weak-moderate La Niña in progress may improve the odds of having a relatively cold January in 2012, but there is no indication that anything like its counterpart in 1950 is on the horizon. If it did somehow happen to occur one of these winters, readers of this newsletter might be able to guess whether the OWSC would relish the opportunity to review another month akin to January 1950.

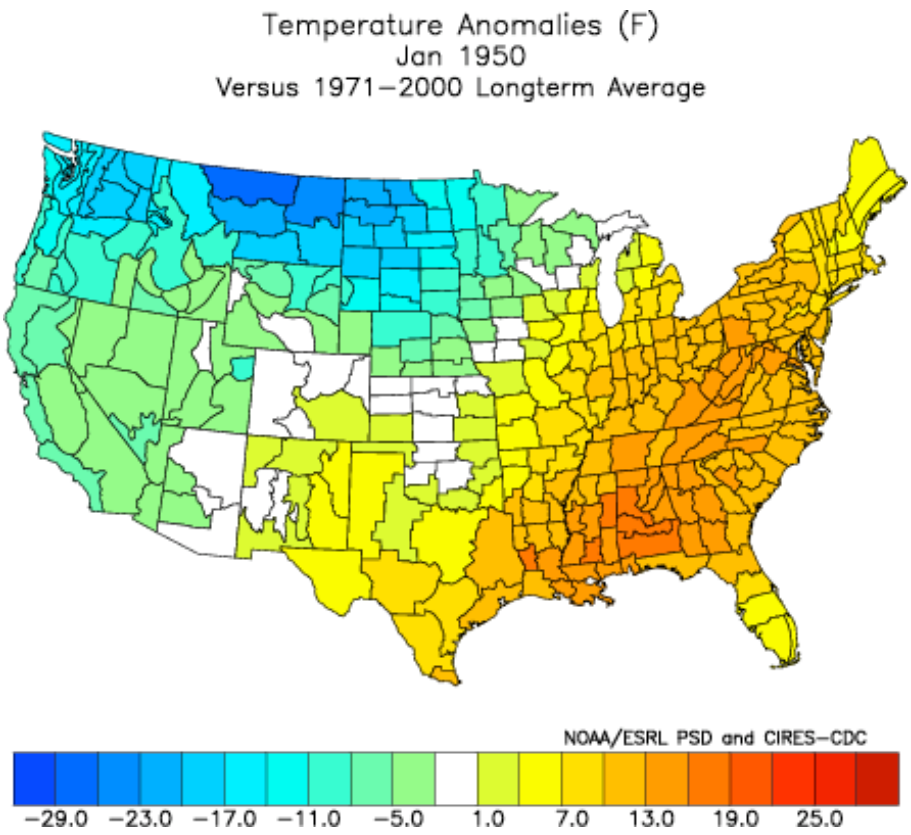


Figure 2: January 1950 temperature anomalies (°F) for the United States compared to the 1971-2000 normal (from ESRL).

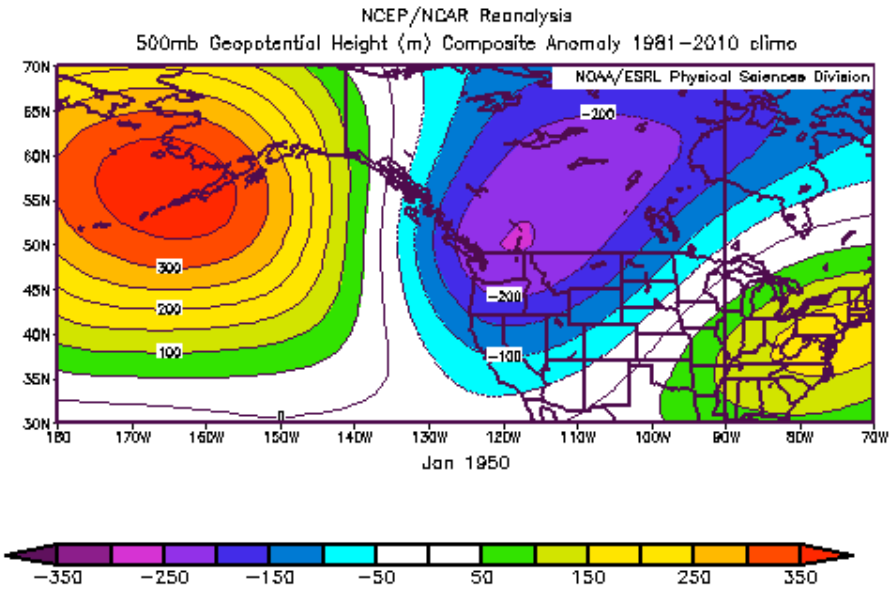


Figure 3: Average 500 hPa geopotential height field during January 1950 compared to the 1981-2010 normal pattern (from ESRL).

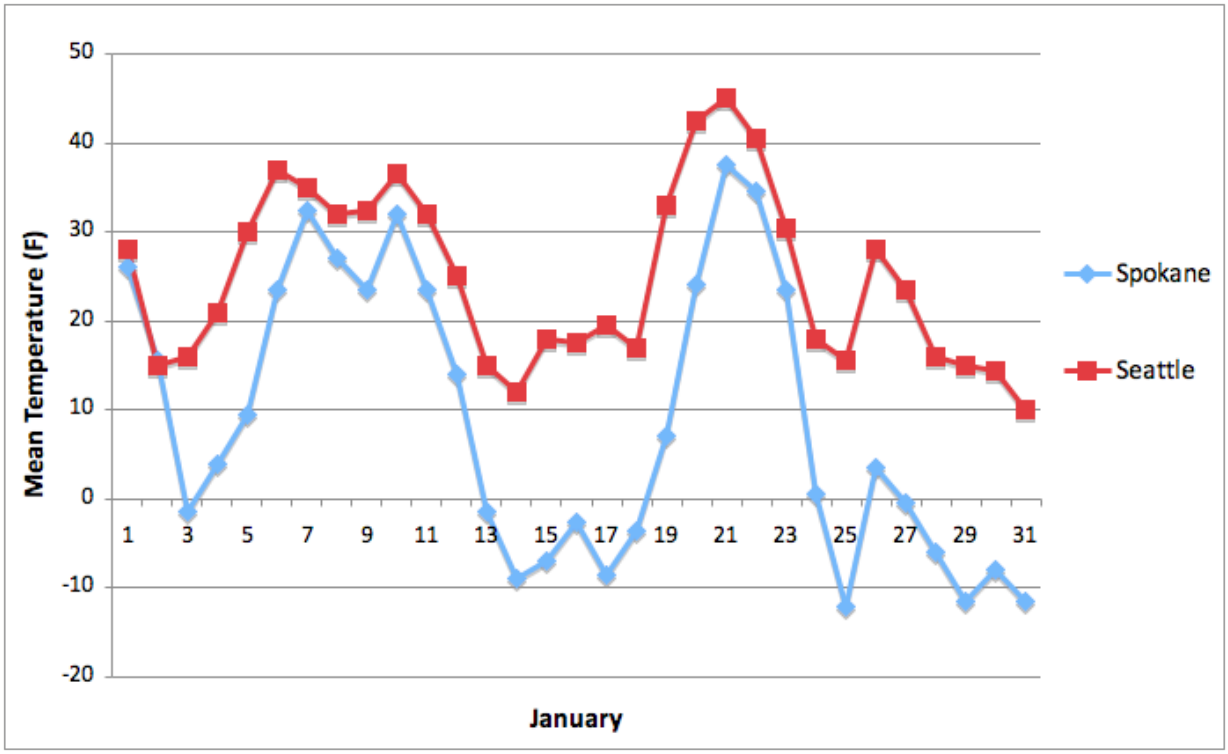


Figure 4: Daily mean temperature (°F) during January 1950 for Seattle (red) and Spokane (blue).

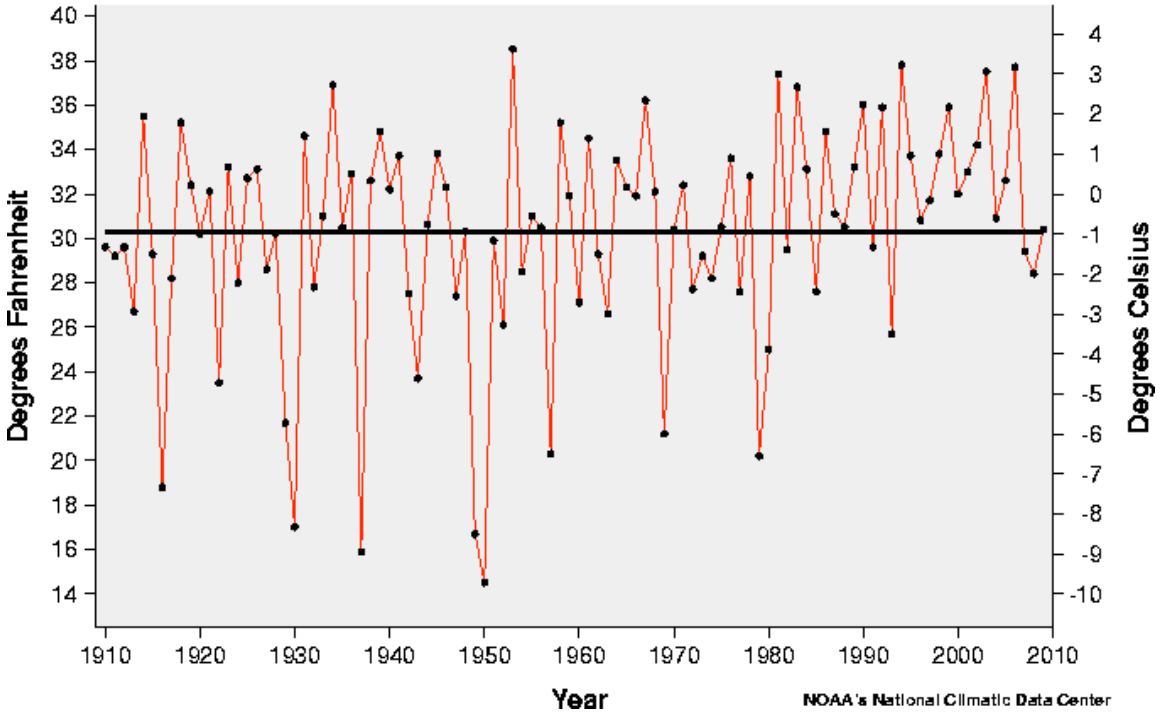
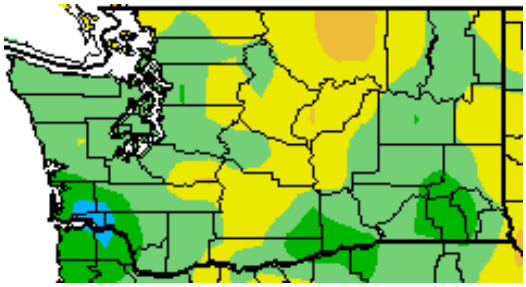


Figure 5: Mean January temperature averaged over WA from 1910 to 2009 (red) and long-term average (black; 1910-2009) from NCDC.

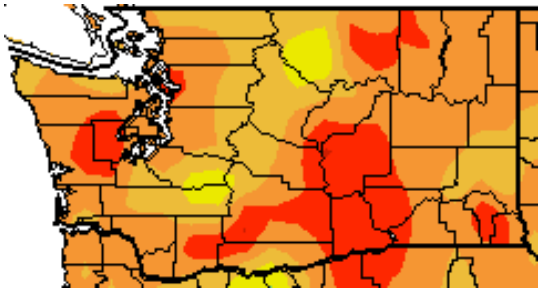
Climate Summary

Average December temperatures were within 1.5°F of normal for most of Washington State, with the majority of the state on the cooler side. Some areas along the southern border of the state were cooler than 2°F for the month, such as Pasco (2.3°F below normal; Table 2). Whatcom County and the eastern slopes of the Cascades were on the warm side, and an area of Okanogan County was more than 2°F above normal for the month.

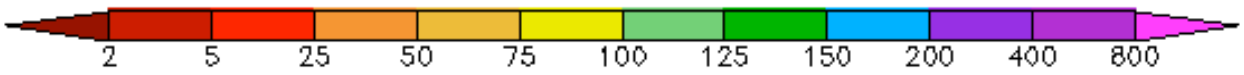
Total December precipitation was below normal for the entire state, with most of the state extremely dry for the month – receiving less than 50% of normal precipitation (e.g., SeaTac at 42% of normal; Bellingham at 50% of normal; Table 2). Parts of the Yakima Basin and Mason County (Olympic Peninsula) received between 5 and 25% of normal precipitation (e.g., Yakima at 22% of normal; Pasco at 12% of normal; Table 2). There were a few areas of the state that fared better: southwestern Okanogan County and parts of Pierce and Lewis Counties received between 75 and 100% of normal monthly precipitation. Additionally, Pullman precipitation came in at 91% of normal (Table 2).



Temperature (°F)



Precipitation (%)



December temperature (°F) departure from normal (top) and December precipitation % of normal (bottom). Source: High Plains Regional Climate Center (http://www.hprcc.unl.edu).

	Mean Temperature (°F)			Precipitation (inches)			Snowfall (inches)		
	Avg	Norm	Departure from Normal	Total	Norm	% of Norm	Total	Norm	% of Norm
Western Washington									
Olympia	36.9	38.4	-1.5	4.69	7.46	63	0	2.6	0
Seattle WFO	40.7	41.1	-0.4	1.49	5.43	27	0	2.3	0
Sea-Tac	39.2	40.6	-1.4	2.24	5.35	42	0	1.7	0
Quillayute	39.7	40.4	-0.7	7.90	12.99	61	0	2.1	0
Bellingham AP	39.5	38.1	1.4	2.12	4.22	50	M	2.9	M
Vancouver	39.2	40.6	-1.4	2.48	6.77	37	M	M	M
Eastern Washington									
Spokane AP	28.6	27.4	1.2	1.01	2.30	44	2.4	14.6	16
Wenatchee	29.7	27.9	1.8	0.22	1.40	16	M	12.9	M
Omak	27.5	25.7	1.8	0.52	2.54	20	M	M	M
Pullman	31.2	30.1	1.1	1.43	1.57	91	M	M	M
Ephrata	28.5	27.4	1.1	0.21	1.24	17	M	7.6	M
Pasco AP	32.1	34.4	-2.3	0.13	1.13	12	T	0.4	0
Yakima AP	29.0	28.5	0.5	0.34	1.53	22	0.2	9.7	2

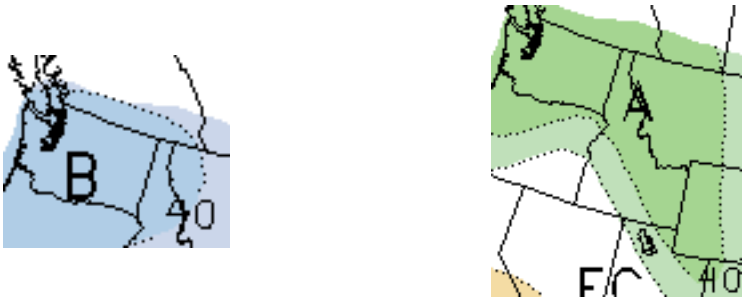
Table 2 - December climate summaries for locations around Washington with a climate normal baseline of 1981-2010. Note that the Vancouver Pearson Airport 1981-2010 normal involved using surrounding stations in NCDC's new normal release, as records for this station began in 1998.

Climate Outlook

Weak-to-moderate La Niña conditions are still present in the equatorial Pacific Ocean, and are expected to last through the boreal winter. Most of the central and eastern equatorial Pacific Ocean has had sea-surface temperature (SST) anomalies at least 0.5°C below normal during the last 4 weeks, according to the Climate Prediction Center (http://www.cpc.noaa.gov/products/precip/CWlink/MJO/enso.shtml; CPC). The drier than normal Pacific Northwest conditions that have been evident this fall were not expected with the weak-to-moderate La Niña present. Nevertheless, La Niña only tips the odds towards wetter and colder conditions, and drier than normal conditions have accompanied La Niña events in the past. Furthermore, there isn't any indication that the drier than normal pattern will continue for the remainder of the winter season. In fact, the CPC outlook indicates otherwise.

The January CPC temperature outlook calls for a continuation of the cooler than normal conditions statewide, with chances exceeding 40% on the three-class system. Also exceeding 40%, is the chance of above normal precipitation statewide for January.

The CPC 3-month seasonal outlook for January-February-March (JFM) calls for cooler than normal temperatures statewide, with a higher likelihood of below normal temperatures for the western two-thirds of the state. The JFM precipitation outlook indicates increased chances of above normal precipitation for the whole state (exceeding 40% on the three-class system).



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

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