Office of the Washington State Climatologist

December 2022 Report and Outlook

December 8, 2022

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

November Event Summary

Mean November temperatures were much below normal statewide, and the anomalies were especially large in eastern WA. Averaged statewide, November ranks as the 6th coldest on record, with temperatures 5.1°F below the 1991-2020 normal. Table 1 shows November temperature rankings for some individual stations in WA; most locations in the state were among the top ten coldest. This is in contrast to October 2022, which ranked as the warmest October on record, averaged statewide (check out our piece on temperature swings beginning on page 5). November precipitation was below normal for most locations in western WA but above normal in most location in eastern WA.

Despite the overall dryness in western WA in November, the beginning of the month started out wet. Rain fell on the 1st, and some daily precipitation records were set in the southern parts of eastern WA. For example, record maximum rainfall records were set at Pasco (0.59") and Walla Walla (1.08"). An atmospheric river on the 4th brought even more precipitation around the state, with 0.50-3.00" totals common. Record maximum rainfall records were set at Olympia (3.33"), Hoquiam (2.99"), Quillayute (2.74"), Bellingham (1.91"), and Spokane (0.76") on the 4th. The

In this Issue

November Event Summary.....1

Snowpack and Drought Update.....3

Whipsaw Temperatures.....5

Climate Summary.....8

Climate Outlook.....10

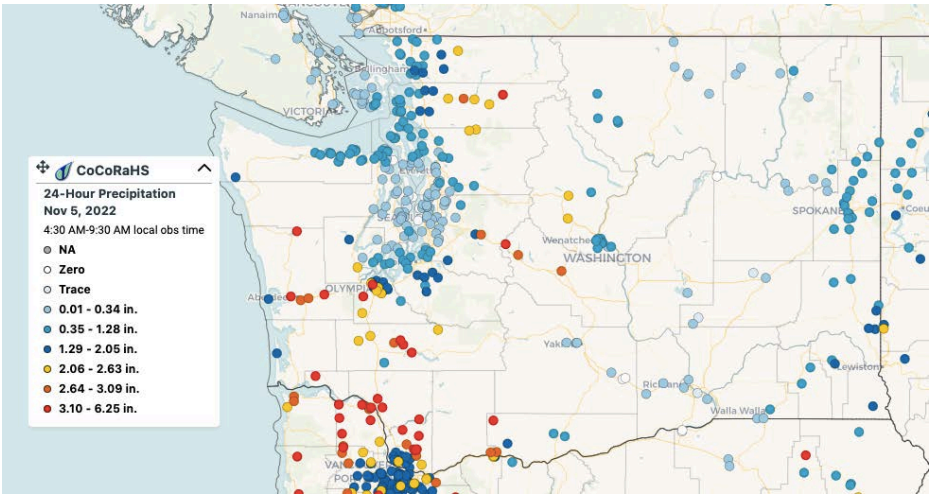


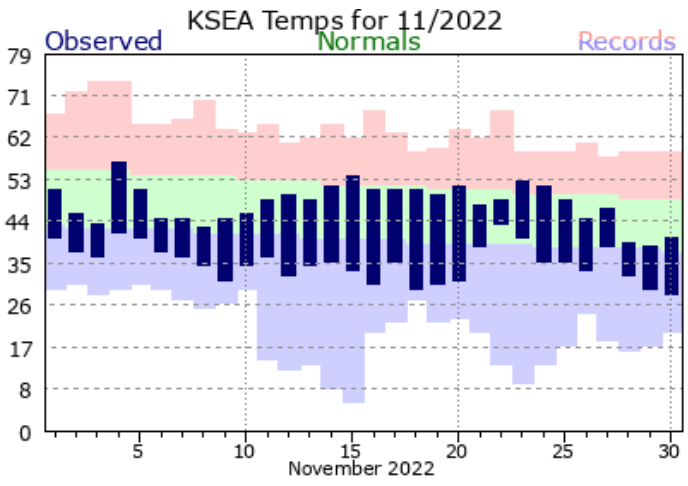
Figure 1: 24-hour precipitation totals measured on the morning of November 5, 2022 from the CoCoRaHS network.

central Puget Sound was relatively dry comparatively, as shown in the map of 24-hr CoCoRaHS precipitation observations made on the morning of the 5th (Figure 1), due to rain shadowing by the Olympic Mountains with the strong westerly flow. Many locations observed wind gusts between 40 and 50 mph later on the 5th.

A trough of low pressure with associated arctic air influenced the state on the 7th, bringing spotty lowland snow in western WA, but more widespread snow in the northern regions of eastern WA. Spokane International Airport set a maximum daily snowfall record with 3.6" on the 7th. Heavy snow fell in the mountains during the first week of November but then a major pattern shift occurred as the trough aloft kept cold, dry air in place as quite high surface pressures built into the region. Colder than normal temperatures were frequent, and there was an extended dry spell. Daily record low minimum temperatures were set at Olympia (18°F) and Quillayute (24°F) on the 19th, for example. Regarding the long stretch of dry weather, SeaTac Airport set the record for the most consecutive November days without measurable precipitation with 14 days (Nov 8-21; Figure 2). The previous record of 13 days was set in 2000.

Station	November Average Temperature (°F)	Rank	Records Began
Pasco Tri Cities	35.3	1	1998
Spokane AP	28.5	4	1881
SeaTac AP	41.9	6 (tie)	1945
Yakima AP	32.3	5 (tie)	1946
Wenatchee Pangborn AP	30.1	2	1960
Quillayute	41.3	6	1966
Bellingham AP	39.2	4	1949
Olympia	38.7	3	1941
Pullman 2 NW	32.0	6	1941
Walla Walla	34.7	3	1949
Vancouver Pearson	42.2	2	1998

Table 1: November average temperature rankings (coldest to warmest) for selected WA locations.



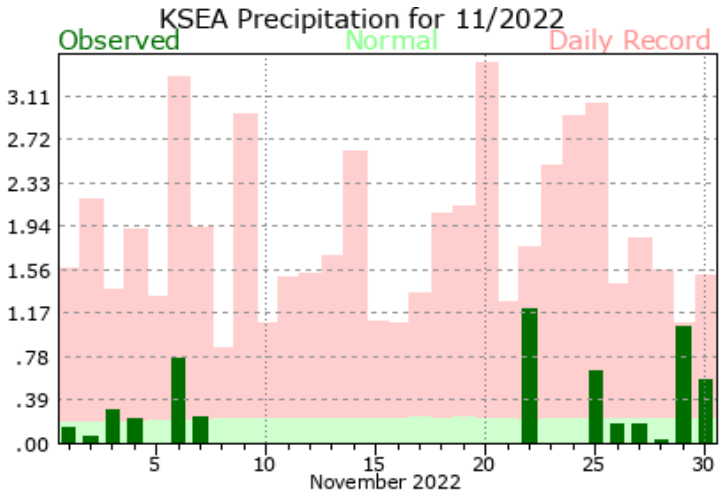


Figure 2: November 2022 daily temperatures for SeaTac International Airport compared to the 1991-2020 normal (green envelope) and previous records (blue and red envelopes; NWS).

Precipitation returned just before Thanksgiving for a fairly active pattern at the end of the month. Another arctic air outbreak began on the 27th, with spotty lowland snow and mountain snow through the end of the month. Spokane measured a record daily snowfall on the 30th with 7.5". Spokane's monthly total snowfall of 18.5" has been surpassed in November before, but is definitely a total more commonly seen in December or January.

Streamflow and Drought Summary

The basin average snow water equivalent (SWE) percent of normal from the Natural Resources Conservation Service (NRCS) as of December 1 (Figure 3) was normal to above normal throughout WA State. The Central Puget Sound, South Puget Sound, Lower Columbia, Klickitat, Lower Yakima, Spokane, and Lower Snake-Walla Walla basins had basin average SWE between 153 and 179% of normal on the 1st. The Olympic and North Puget Sound basins were near-normal. It's hard to tell by the basin averages that there were several weeks in November without falling snow. The snow that built by December 1 was very episodic, with two periods of snowpack growth. The first occurred in early November (between about the 3rd and the 9th, depending on the site) and the last occurred at the end of the month, beginning on about the 27th and lasting through early December. In between, the month was remarkably dry.

Because of the extended dry period, average November streamflow (not shown) was still below to much below normal for locations throughout western WA and north central and northeastern WA. Nevertheless, the monthly streamflow percentiles were generally higher than those for October.

There have been some improvements to the U.S. Drought Monitor (Figure 4) over the last month in response to the two wet periods and above normal snowpack. Notably southeastern WA is drought-free due to near- and medium-term precipitation being above normal. While further improvements are expected if the Climate Prediction Center's seasonal forecasts pan out, there is some concern for continued drought conditions come spring. With our dry fall, rain was unable to saturate the soils to the usual extent in some locations before snow began to fall. When our snow does begin to melt in the spring, there is a possibility that more of the melt will be absorbed by the soils rather than runoff in our rivers. This is something we will continue to monitor throughout the winter.

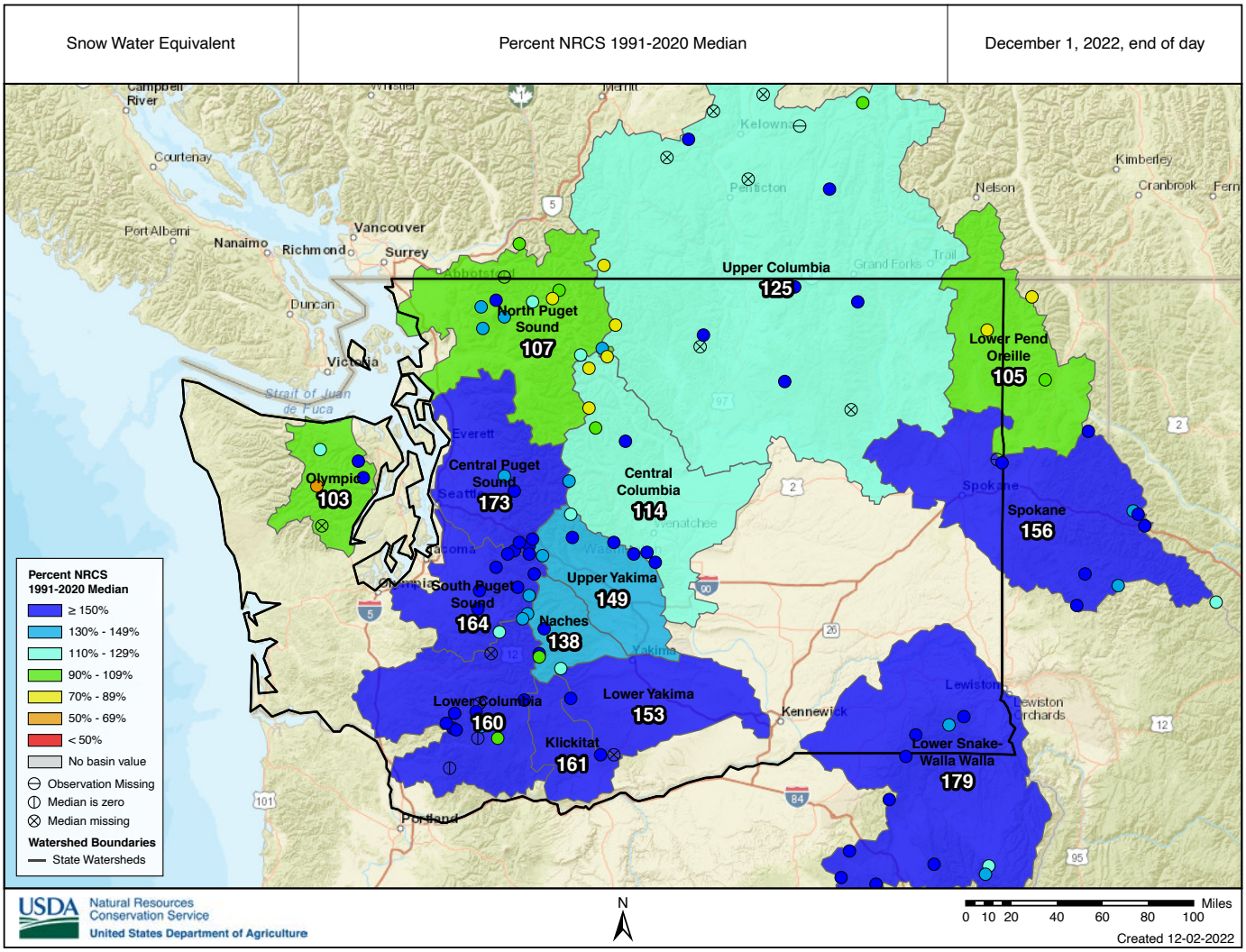


Figure 3: Snowpack (in terms of snow water equivalent) percent of normal for Washington as of December 1, 2022 (NRCS).

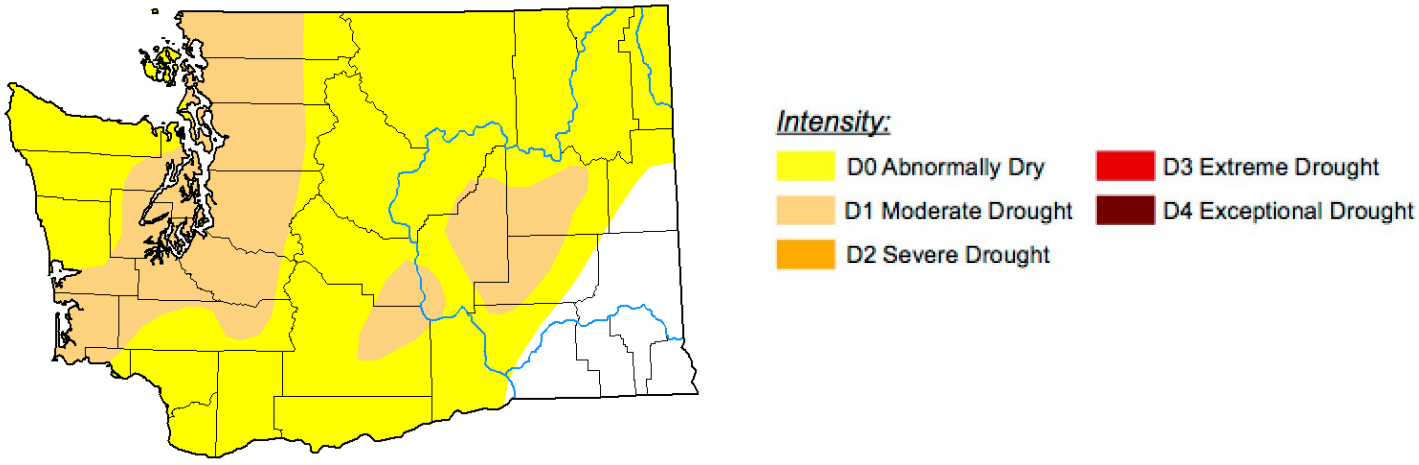


Figure 4: The December 8, 2022 edition of the U.S. Drought Monitor.

Whipsaw - From an Exceedingly Warm October to a cold November 2022

A Message from the State Climatologist

As described in this newsletter, WA state experienced unseasonably cold temperatures in November 2022 after record warm temperatures in the previous month. OWSC has received a variety of inquiries about the rapid transition from summer to winter this year. Folks are curious whether there is precedent for such a marked change in temperatures from one month to another, and how the magnitude of this kind of variability is trending. Let's take a look.

Our specific interest here is to describe how the month-to-month fluctuations in WA statewide temperature anomalies have played out over the historical record. One feature of the climate of the state is the relatively rapid decrease in mean temperatures during the fall, compared to the slower rise in temperatures in spring, which is more or less drawn out over the months of March through June. So here the emphasis is on the fluctuations about the mean annual cycle, which is

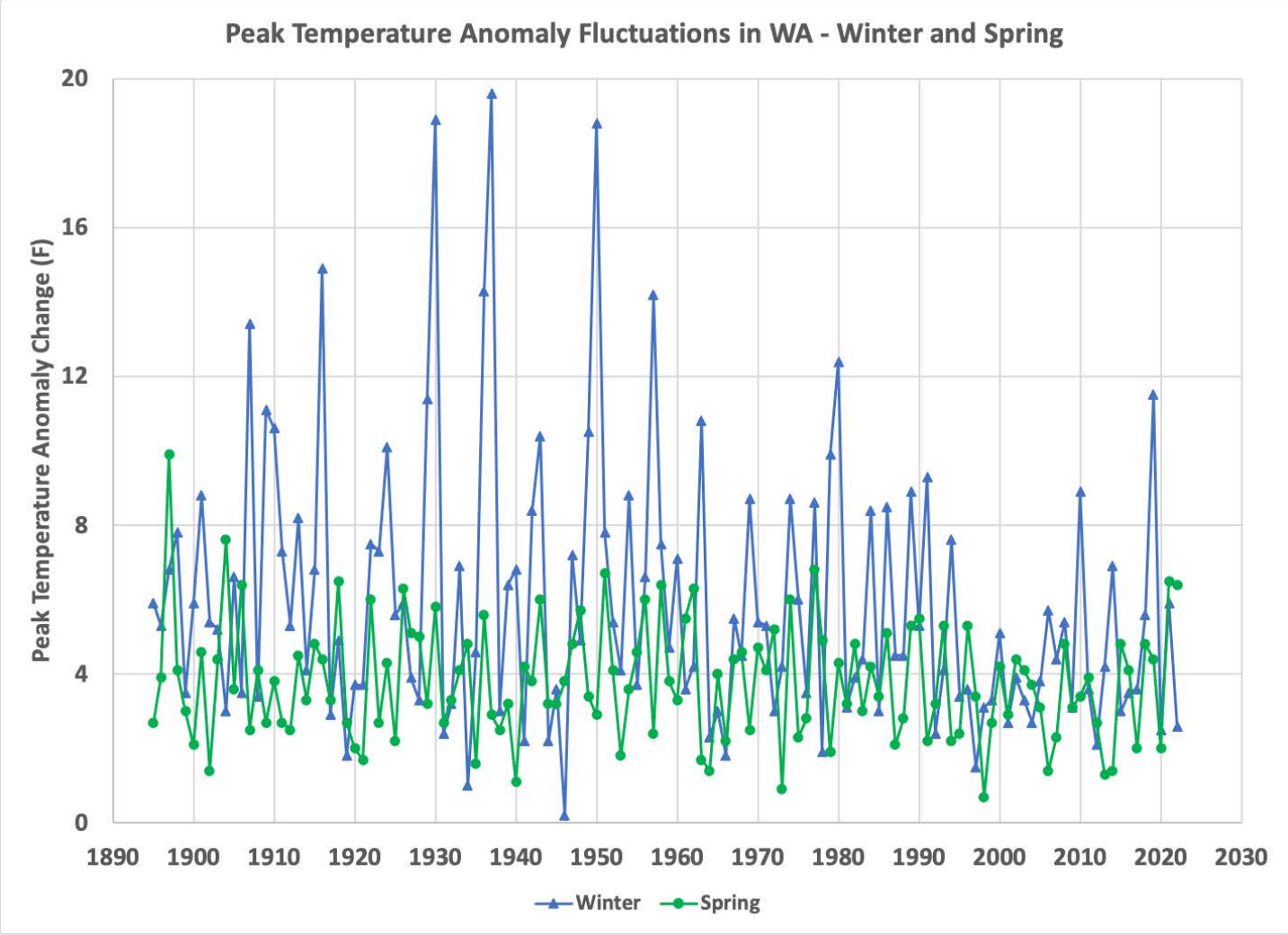


Figure 5: The annual peak temperature anomaly change for WA State as whole for winter (blue) and spring (green) from 1895 to 2022.

why we consider monthly mean temperature anomalies using a climatology based on the 30-year period of 1991-2020. The source of temperature information is NOAA's Climate at Glance, from which time series of statewide temperature anomalies were extracted for each month of the year over the interval of 1895-2022. Our analysis involved simply computing the absolute values of the month-to-month changes in statewide temperature anomalies, lumping them by season, and computing the greatest one-month difference for that season and year. In other words, if March of a given year was 4°F below normal and the following April was 4°F above normal, that would be a monthly temperature change of 8°F. Time series of those absolute values of the greatest changes over the years are plotted for winter and spring in Figure 5, and for summer and fall in Figure 6.

The greatest values of these fluctuations tend to occur in the winter season (Dec-Jan, Jan-Feb, and Feb-Mar). The extreme values all occur in the first half of the record during which there were a handful of bitterly cold Januarys, with anomalies of about -17 to -19°F, bracketed by months with much more typical temperatures. The last really cold January for WA occurred in 1979 with a statewide temperature anomaly value of -13.1°F. The much more recent big swing in winter is

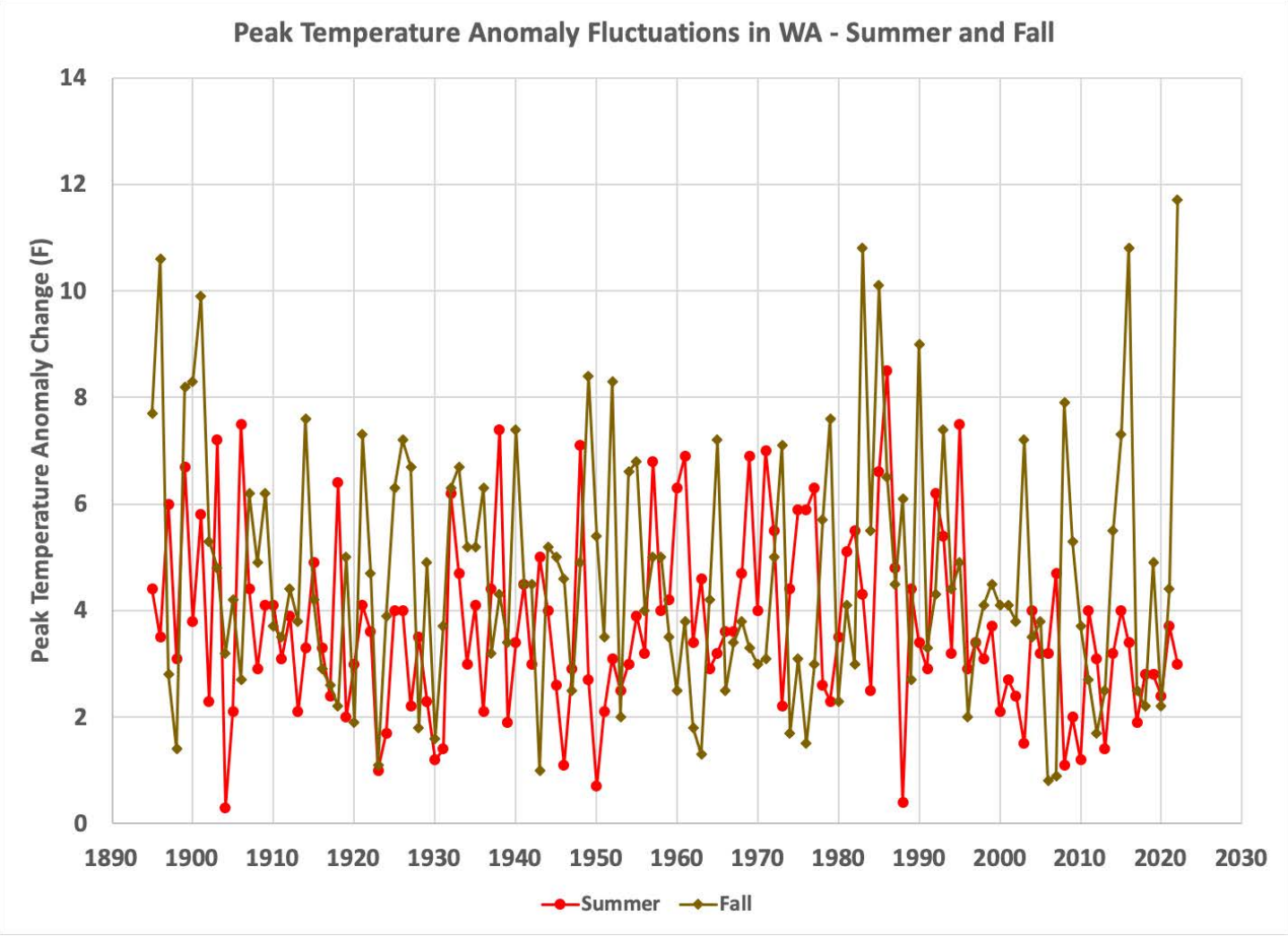


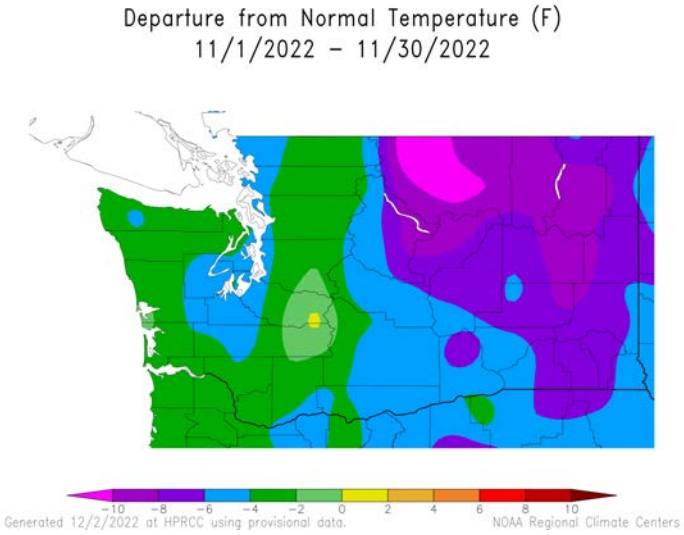
Figure 6: As in Figure 5, except for summer (red) and fall (brown).

represented by the change in anomalous temperature from +2.3 to -9.2°F from January to February 2019. As an aside, the cold weather during the late winter of 2019 coincided with weak-moderate El Nino conditions, which in some ways makes it even more remarkable. Figure 1 also shows that the month-to-month swings in temperature in spring (Mar-Apr, Apr-May, and May-Jun) are quite modest relative to winter. The last two years have included relatively large values, namely the change from -0.2 to +6.3°F during May to June 2021, and the change of the other sense from +1.7 to -4.7°F during March to April of 2022. Both the winter and spring time series suggest a very weak tendency for declining variability with time but it is highly doubtful these trends are significantly different from zero (we have not bothered to compute their statistical significance).

The time series of the temperature fluctuations for summer (Jun-Jul, Jul-Aug, and Aug-Sep) and fall (Sep-Oct, Oct-Nov and Nov-Dec) are shown in Figure 2. Note the change in vertical scale compared to Figure 1; the peak fluctuations during each summer are of comparable value to those of spring. Their magnitudes during the fall are generally somewhat greater, but still considerably less than that during the winter. The transition from +6.6 to -6.0°F from October to November 2022, i.e., a change of 12.6°F does represent an all-time record for the fall season. Tied for second place are two relatively recent years, 1983 and 2016, during which warm Novembers were followed by cold Decembers. Still, there doesn't appear to be systematic change in fall temperature variability. The summers of the last 25 years or so have included relatively small fluctuations, but just as for winter and spring, it would be difficult to make the case that this measure of the variability has systematically changed over the record. But we can still marvel at how fast the weather cooled during the past couple of months, and hope sometime before too long, that we have another substantial switch of one sense or the other.

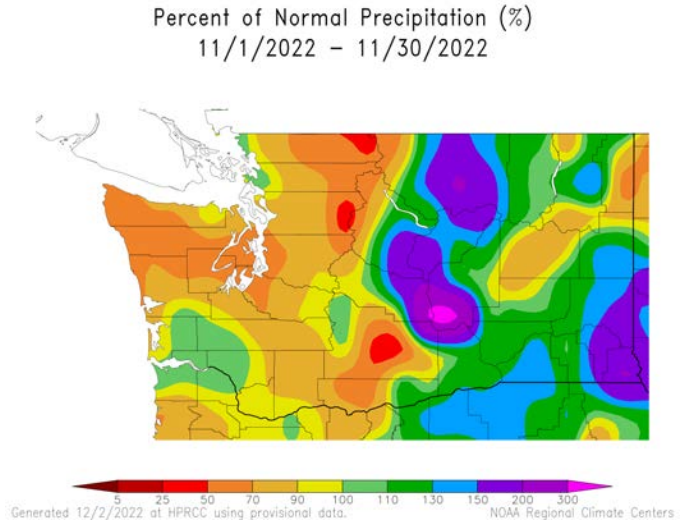
Climate Summary

In contrast to October, average November temperatures were much below normal statewide, as shown in the plot from the High Plains Regional Climate Center. Temperatures were especially anomalous in north central WA. Omak, for example, was 10.5°F below normal (Table 2). A larger area of eastern WA had November temperatures between 6 and 8°F below normal. Temperatures were not as anomalous in western WA, but still well below normal. Most locations had temperatures between 3 and 5°F below normal for the month as a whole.



November temperature (°F) departure from normal relative to the 1991-2020 normal (HPRCC).

Total November precipitation was generally below normal west of the Cascade Mountains and above normal east of the Cascade Mountains, with a few exceptions. The coast, Olympic Peninsula, the central Puget Sound region, and the northern Cascades had the lowest percentages of normal, with those areas only seeing between 50 and 70% of normal precipitation. Quillayute, for example, had 69% of its usual precipitation. Hoquiam and Vancouver received near-normal precipitation (Table 2). Precipitation in eastern WA was above normal in most locations. Wenatchee, for example, reported 205% of normal. Parts of Yakima and Klickitat counties were exceptions with below normal precipitation. Yakima, for example, only received 67% of normal precipitation.



November total precipitation percent of 1991-2020 normal (HPRCC).

Station	Mean Temperature (°F)			Precipitation (inches)			Snowfall (inches)		
	Avg	Norm	Departure from Normal	Total	Norm	Percent of Normal	Total	Norm	Percent of Normal
Western Washington									
Olympia	38.7	43.2	-4.5	8.18	8.21	99	-	-	-
Seattle WFO	42.9	46.4	-3.5	5.15	5.85	88	0.2	0.2	100
SeaTac AP	41.9	46.5	-4.6	4.83	6.31	77	1.1	0.2	550
Quillayute	41.3	44.7	-3.4	10.59	15.26	69	-	-	-
Hoquiam	44.6	45.9	-1.3	10.27	10.95	94	-	-	-
Bellingham AP	39.2	44.2	-5.3	4.51	5.20	87	-	-	-
Vancouver AP	42.2	46.2	-4.0	5.25	5.51	95	-	-	-
Eastern Washington									
Spokane AP	28.5	36.3	-7.8	3.03	2.06	147	18.5	6.2	298
Wenatchee	30.1	37.4	-7.3	1.74	0.85	205	-	-	-
Omak	25.4*	35.9	-10.5	2.65*	1.24	214	-	-	-
Pullman AP	31.6	38.6	-7.0	4.01	2.14	187	-	-	-
Ephrata	30.6	37.6	-7.0	1.03	0.86	120	-	-	-
Pasco AP	35.6	40.9	-5.3	1.11	0.87	128	-	-	-
Hanford	33.3	40.3	-7.0	0.75	0.80	94	3.4	1.5	227

Table 2: November 2022 climate summaries for locations around Washington with a climate normal baseline of 1991-2020. *Two days are missing.

Climate Outlook

La Niña conditions are still present in the Pacific Ocean and a "La Niña Advisory" remains in effect, according to the Climate Prediction Center (CPC). Below normal sea-surface temperatures are present throughout the central and eastern equatorial Pacific Ocean and the atmospheric response is consistent with La Niña. The weak-to-moderate La Niña is expected to continue through this winter. According to ENSO models, there is a 59% chance of La Niña persisting through the January through March period compared to 40% for neutral conditions.

The CPC outlook for December (Figure 7) indicates a higher probability of below normal temperatures and above normal precipitation statewide. The odds of below normal temperatures are higher for the eastern two-thirds of the state, leaving the Olympic Peninsula and southwest WA with lower odds of below normal temperatures. The probability of above normal December precipitation is the same across the entire state and just slightly elevated (33-40% on the three-tier scale).

The three-month outlook for winter (December-January-February; DJF) is similar to the December outlook, calling for higher probabilities of below normal temperatures and above normal precipitation statewide (Figure 8). The highest odds (40-50%) for above normal precipitation are centered over northern Idaho/western Montana extending into far eastern WA. The higher chance of below normal temperatures and above normal precipitation for DJF is primarily based on the type of weather received during past La Niña events.

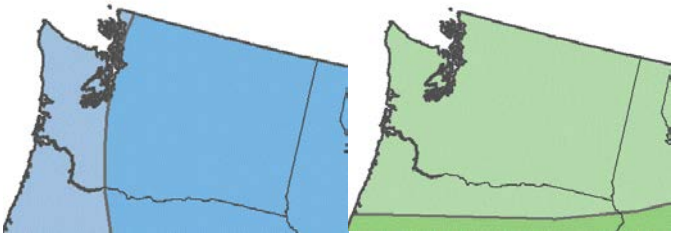
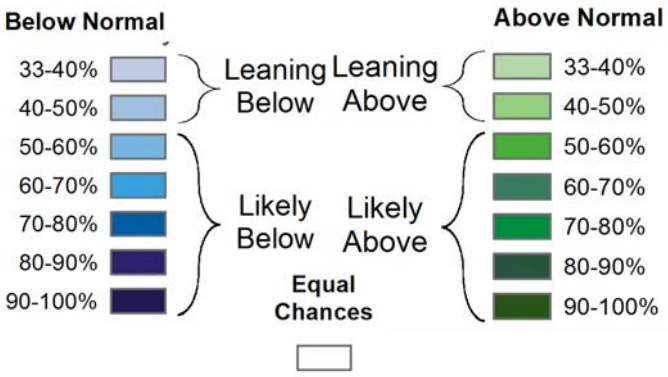


Figure 7: December outlook for temperature (left) and precipitation (right).



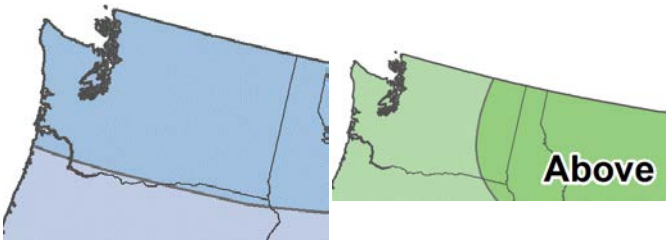


Figure 8: December-January-February outlook for temperature (left) and precipitation (right) (Climate Prediction Center).