Office of the Washington State Climatologist

December 2023 Report and Outlook

December 6, 2023

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

November Event Summary

Mean November temperatures were generally below normal in the lower elevations and above normal in the higher elevations across Washington State, with areas of near-normal temperatures as well. The pattern of warmer temperatures in higher elevations can be attributed to the high pressure that dominated our weather during the second half of the month, causing foggy and cool mornings in the lowlands and temperature inversions with limited near-surface mixing. Total November precipitation was below normal for nearly the entire state. The exception was parts of southeastern Washington where November precipitation was near-normal.

The month began with heavy rain, particularly in western Washington. Figure 1 shows the 24-hour precipitation totals from CoCoRaHS volunteers on the morning of the 2nd. Quinault - a red dot in the middle of the Olympic Peninsula - recorded an

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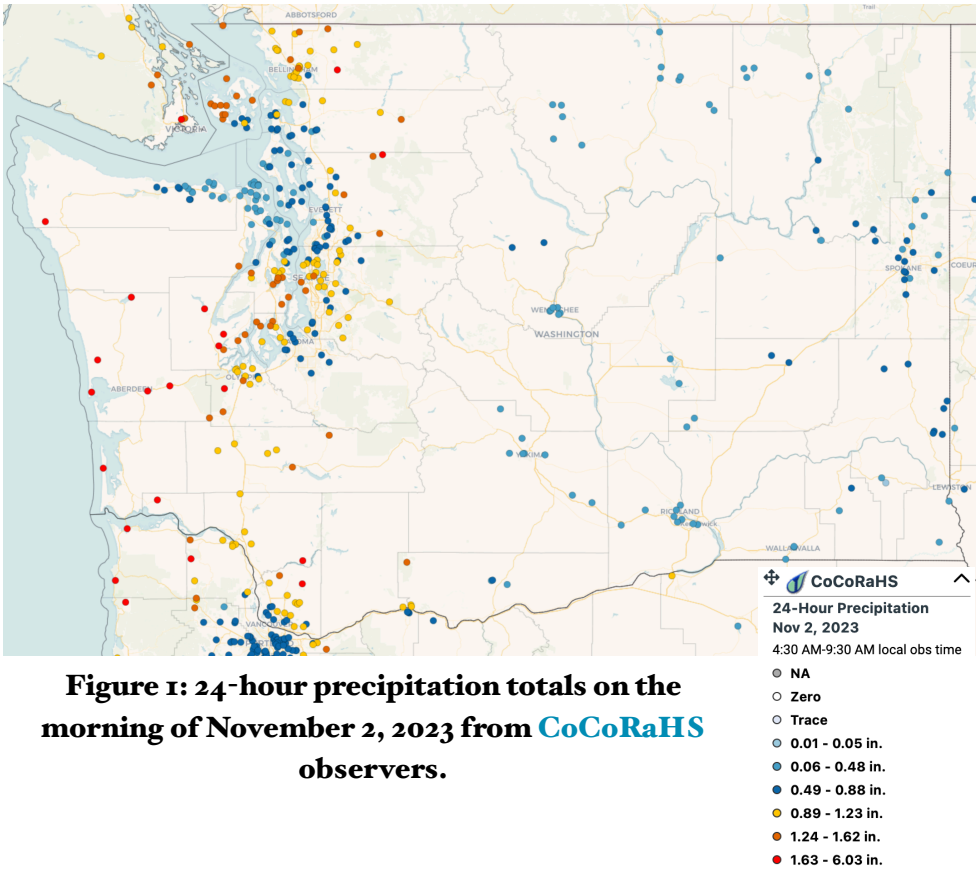


Figure 1: 24-hour precipitation totals on the morning of November 2, 2023 from CoCoRaHS observers.

impressive 6.03". Bellingham recorded a maximum daily rainfall record on the 2nd with 1.46". Some brisk winds were associated with this atmospheric river, and the first week of the month was wetter than usual for most of the state. Even eastern WA received substantial precipitation; Figure 2 shows the November daily temperatures and precipitation at Spokane International Airport. Dallesport measured a record daily rainfall maximum on the 4th with 0.90".

Otherwise, the November weather was rather quiet. The bulk of the precipitation that fell occurred in the first half of the month. High pressure dominated the second half of the month and brought drier than usual conditions. Thanksgiving weekend was remarkably dry with very little precipitation measured around the state.

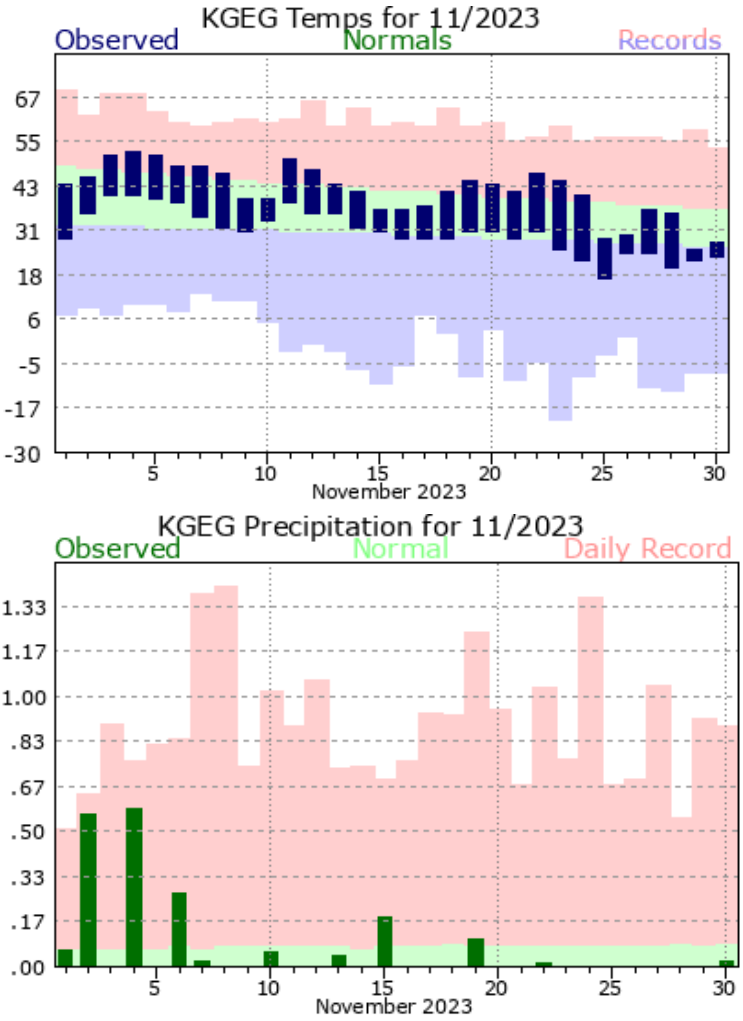


Figure 2: November 2023 daily temperatures (left) and precipitation (right) for Spokane International Airport compared to the 1991-2020 normal (green envelope) and previous records (blue and red envelopes; NWS).

Streamflow and Drought Summary

The basin average snow water equivalent (SWE) percent of median from the Natural Resources Conservation Service (NRCS) as of December 1 (Figure 3) was much below normal across Washington State. While some significant snow fell in the mountains on December 3 and 4, it remains unlikely that that will remain, given the looming atmospheric river at the time of this writing. For this reason, we are showing snowpack as of December 1. The Lower Yakima, Klickitat, Central Columbia, and Olympic Basins had the lowest basin average in the state, with about 50% of median snowpack. The South Puget Sound and Naches basins were in better shape, but still below median, with 78 and 70% of median, respectively.

Despite the drier than normal November weather for a majority of the state, streamflows have improved compared to October. Average November streamflows were in the "normal"

category for most of the state (Figure 4) with the exceptions being the central Puget Sound and the northeastern border with Canada. The percentage of stream gauges in each percentile category (Figure 5) gives a better summary of streamflows over the month. Streamflows responded to the drier conditions during the second half of the month, but are overall improved compared to the previous few months. We suspect they are in the normal category, despite the month being dry, for two reasons. The first is that since November is our wettest month of the year, even a drier than normal month provides enough precipitation to get our rivers flowing and second, the lack of snow in the mountains meant that most of the precipitation that did fall was rain that went right into our rivers.

The most recent drought depiction of the U.S. Drought Monitor (valid on November 28) is shown in Figure 6. There have been a few improvements since the last edition of our newsletter, and the area of "extreme drought" was removed from the central and northern Puget Sound. Even with many streamflows in the normal range, we would certainly like to see more mountain snow and precipitation to make up from the deficits of 2023. The drought declared by the Washington State Department of Ecology in 12 watersheds on July 24 (press release) is still in effect. Seattle Public Utilities' request for voluntary efforts to conserve water is also still in effect.

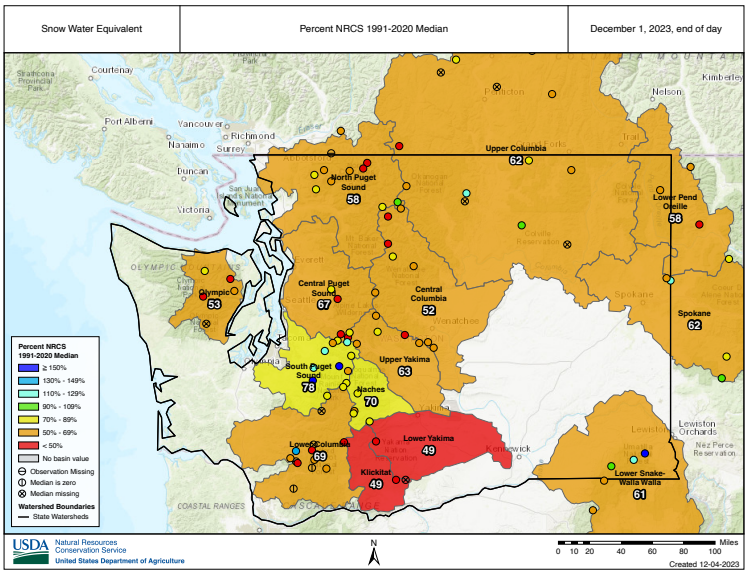


Figure 3: Snowpack (in terms of snow water equivalent) as of December 1, 2023 (NRCS).

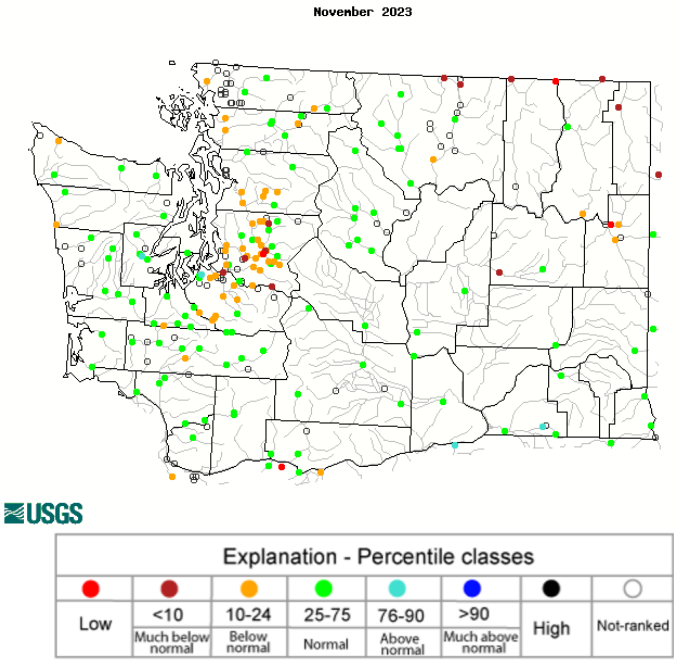


Figure 4: November 2023 average streamflow percentiles (USGS).

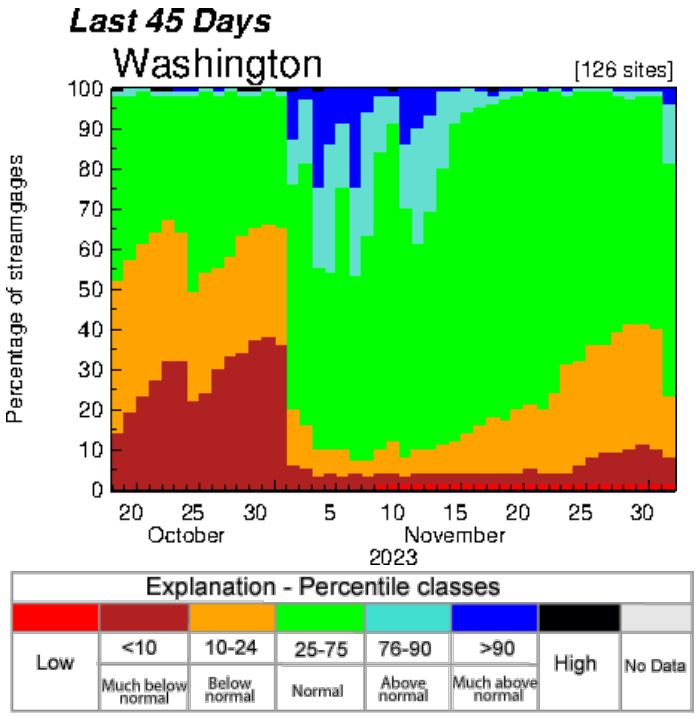


Figure 5: The percentage of stream gauges in WA in each percentile category from late October through November (USGS).

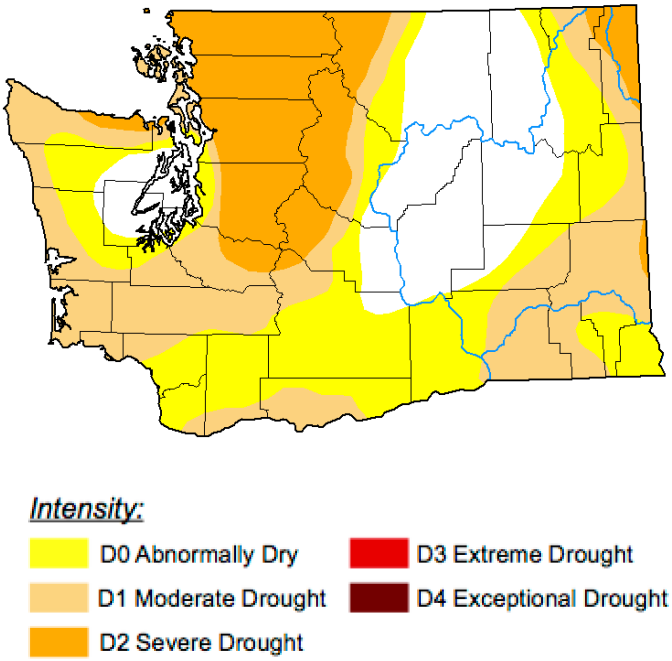


Figure 6: The November 30, 2023 edition of the U.S. Drought Monitor.

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 and partners have developed Condition Monitoring Observer Reports on Drought (CMOR-drought), a short survey that allows the public to enter their observations regarding crops, water supply, fire, etc. We would greatly appreciate your input, and these reports help experts assess drought impacts for both the U.S. Drought Monitor depiction and on the state level.

Plant Hardiness Zones for Washington State

A Message from the State Climatologist

The U.S. Department of Agriculture (USDA) recently released a new plant hardiness zone map (PHZM). The zones are based on the average annual extreme minimum temperature during the years of 1991 through 2020. Importantly, they do **not** reflect all-time minimum temperatures but rather the coldest temperatures that can be expected during a typical year based on the recent climate. This represents an important aspect of a location's microclimate, of course, and is widely used towards the selection of perennial plants.

The material that follows includes comparison with the previous version of the PHZM released in 2012.

PHZM was produced using the Parameter-elevation Relationships on Independent Slopes Model (PRISM) interpolation method developed at Oregon State University. PRISM combines station data from a variety of networks with multiple factors related to the terrain to estimate daily maximum and minimum temperatures,

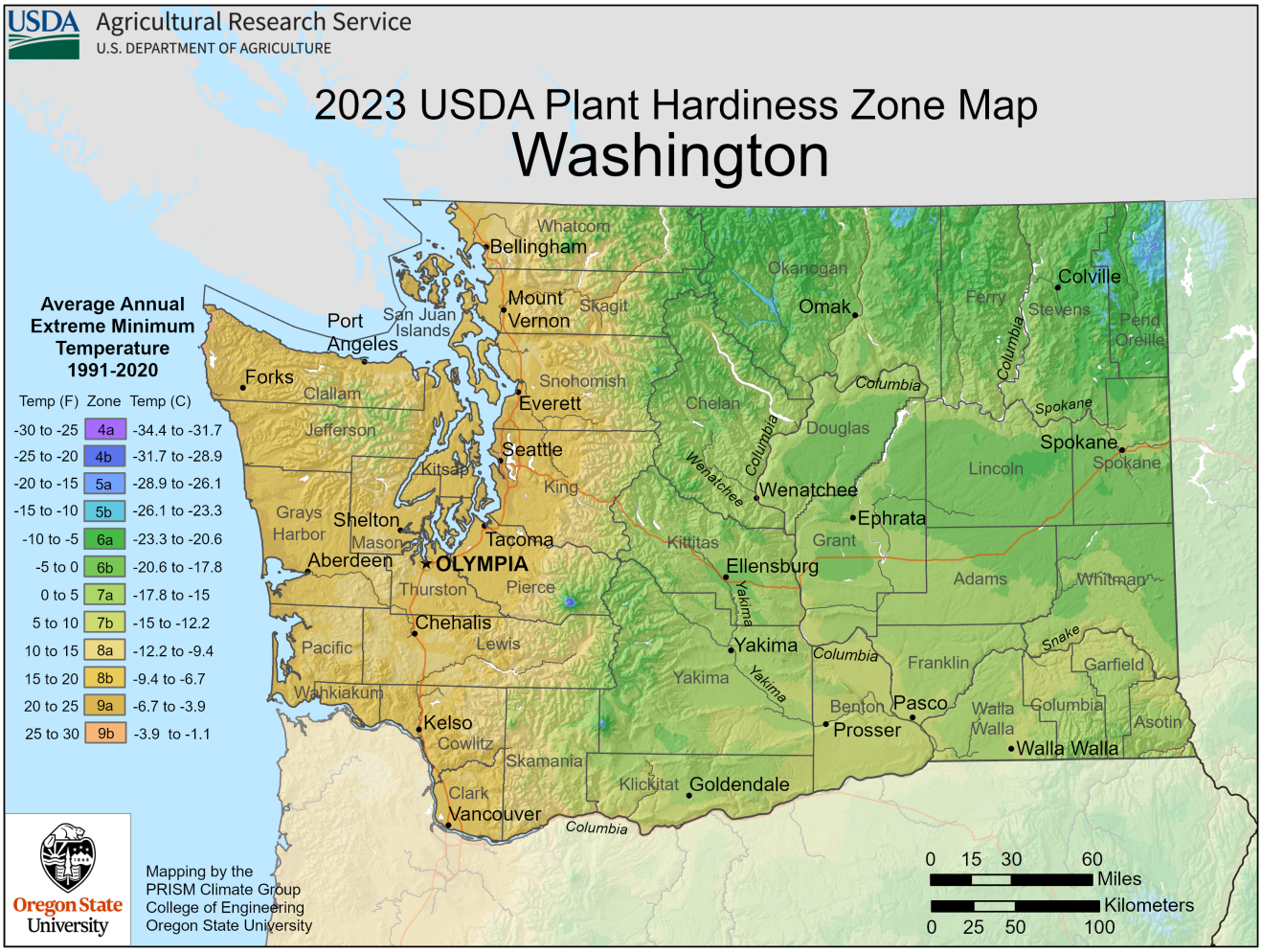


Figure 7: 2023 USDA plant hardiness zone map. Explore online here.

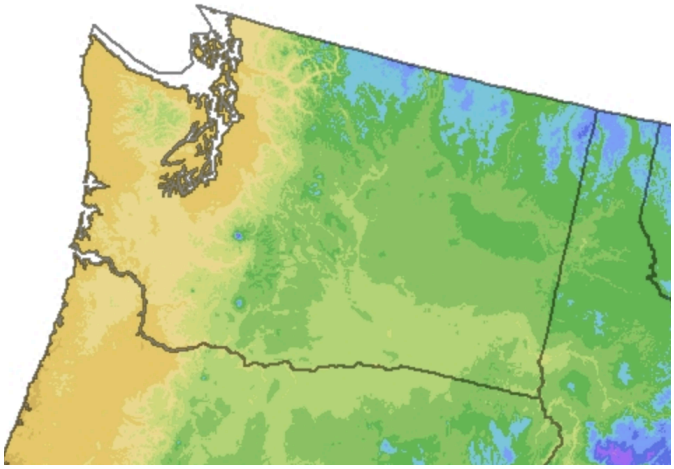


Figure 8: 2012 USDA plant hardiness zone map. Explore online here.

among other weather variables; for the PHZM application this procedure was carried out on a grid with cells about one-half mile on a side. For high elevations, temperatures from atmospheric reanalyses were also incorporated. The new version also better accounts for the effects of nearby bodies of water. The map itself includes zones at 5 degree increments, as shown in the recent released (Figure 7) and the 2012 version (Figure 8).

As far as we can tell, there is not a publicly-available map that illustrates the differences between the two versions. But at least the color scales are consistent, so by inspection some general conclusions can be made about how extreme minimum temperatures have changed in WA state. In some parts of the state, but by no means all, there have been increases by one 5°F category. For example, near the border with Canada in eastern WA, there is much less blue, signifying temperatures in the 5a and 5b categories, in the latest as compared with the 2012 version. For the southern portion of eastern WA, there are now areas in the 7b category (annual extremes down to 5-10°F), whereas the older version had the entire east side in the 7a category and lower. In general, the changes appear more prominent on the east side as compared with the west side of the Cascade Mountains, as expected given the former's more continental climate and for that matter, the results from climate model simulations. That being said, there are also some changes on the west side, with a greater proportion of the lowlands surrounding Puget Sound in the 8b category, with typical annual extremes in the 15-20°F range. And along the Pacific coast there appears to be a narrow band in the 9a category that was lacking before (the color scale here does one no favors).

A complementary perspective on annual extreme temperatures is afforded through consideration of time series from selected stations. Here we consider the records from three west side (Hoquiam, Olympia and SeaTac) and three east side (Yakima, Ritzville and Spokane) stations for the last 50 years. On the west side, the interior but more rural station of Olympia has had a greater overall increase in this metric versus the coastal station of Hoquiam and the more urban location that is SeaTac (Figure 9). On the east side, Spokane has had its extreme minimum temperatures increase to a greater extent than Yakima and Ritzville (Figure 10). Spokane International Airport is not in an area that is undergone extensive development in recent decades, but it is west of the core of the Spokane urban area, and since the coldest weather occurs with overall low-level flow with an easterly component, it is possible that urban heat island effects have played a role. We find it interesting that the interannual fluctuations in extreme minimum temperatures among the three stations on the west side mostly track each other, and that the three stations on the east side are even more in lockstep, but the correspondences between the

west side and east side extremes are weaker. For example, the year of 1996 included quite low extremes for the three locations examined in eastern WA, but was not unusual for the westside locations. There are other years when the west side had some very cold weather, such as 2009, with less unusual results for eastern WA. There are counter examples to be sure; all stations report quite cold minimums in 1990. All that being said, we present these time series in part to emphasize how quite cold temperatures can still occur in WA state, but not as frequently and not to the same extremes.

We close with the thought that while extreme minimum temperatures represent an important element of the winter climate, there are plenty of other variables that matter. It is beyond the scope of the present piece, but how have **maximum** winter temperatures varied over the record? How close are extreme minimum temperatures tied to mean winter temperatures? Perhaps we will be able to address these questions in future newsletters.

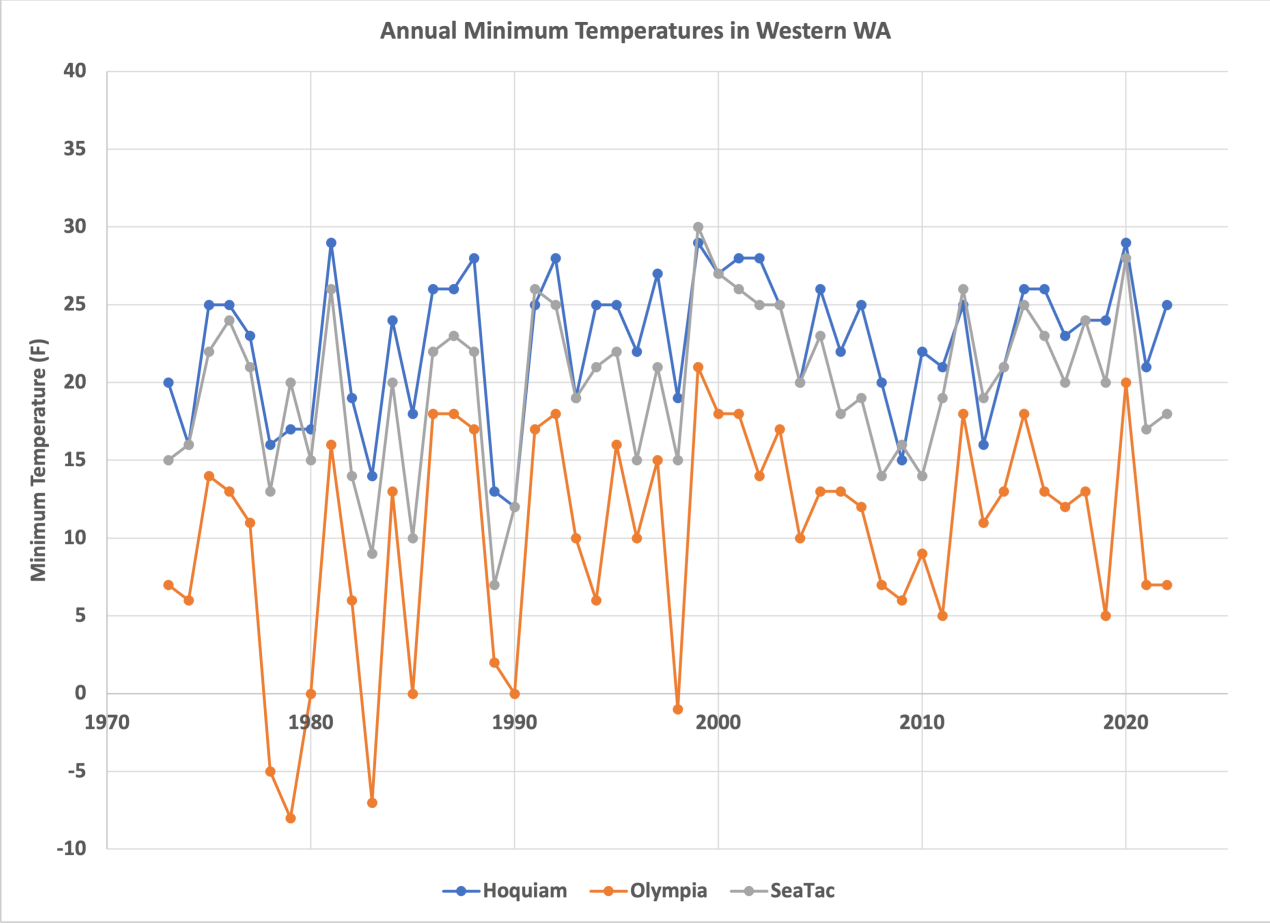


Figure 9: The coldest minimum temperature for each year from 1973-2022 for three stations in western WA (Hoquiam, Olympia, and SeaTac).

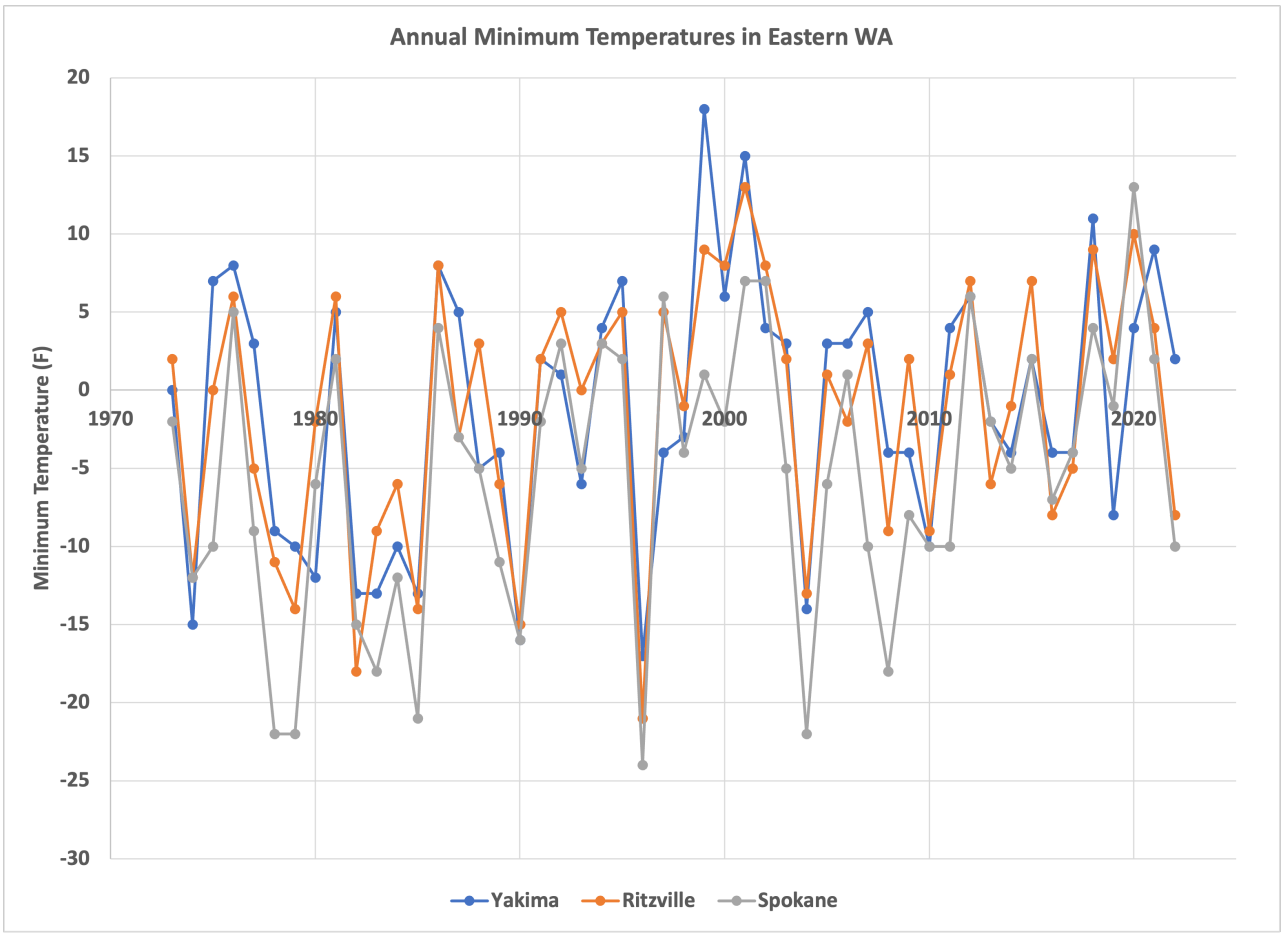
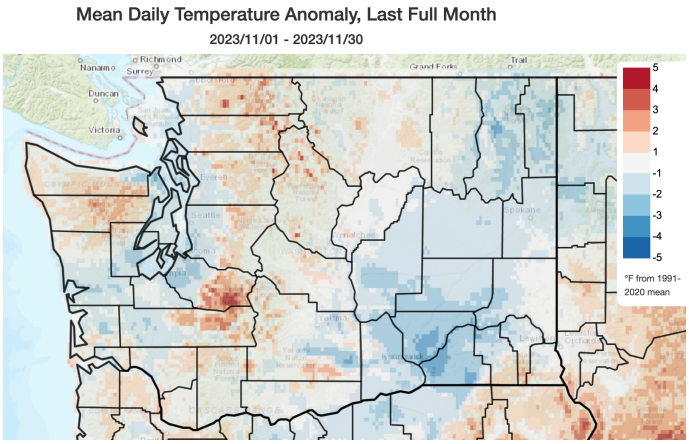


Figure 10: As in Figure 9, except for three stations in eastern WA (Yakima, Ritzville, and Spokane).

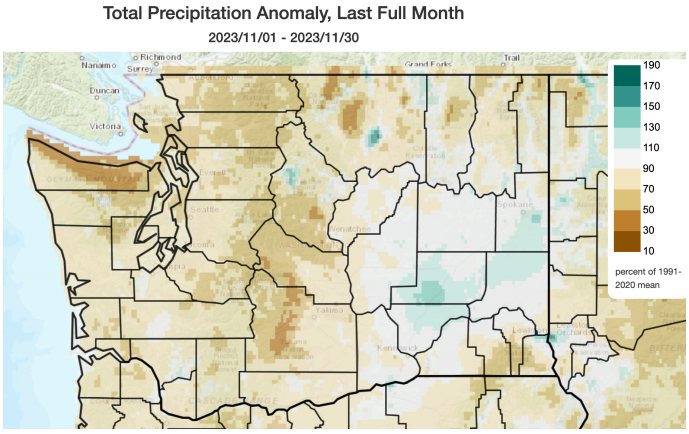
Climate Summary

Mean November temperatures were below normal for most of the lower elevations around WA State, above normal in most of the mountainous areas, and near-normal in others. In other words, temperature anomalies were dependent on location for November, even more so than usual. Bellingham, SeaTac Airport, and Hoquiam were a few of the colder than normal locations, with temperatures 2.0, 1.7, and 1.0°F below normal, respectively (Table 1). East of the Cascades, many of the populated locations had temperatures near-normal, which we define as within 1°F of normal. Omak was the exception, with temperatures 1.7°F above normal. Elsewhere in the state, Quillayute and Olympia were warmer than usual, with anomalies 2.2 and 1.3°F above normal, respectively.



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

Climatologically the wettest month of the year, November precipitation was below normal for a majority of the state. While most of the state received between 70 and 90% of normal precipitation, there were some parts of the northern Olympic Peninsula, northern Puget Sound, and central Cascades that received less than that (between 30 and 70% of normal, according to the map). In contrast, parts of eastern WA had normal to slightly above normal precipitation. Specifically, Omak, Ephrata, and Pullman all had near-normal precipitation at 101, 102, and 105% of normal, respectively (Table 1).



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

Station	Mean Temperature (°F)			Precipitation (inches)		
	Average	Normal	Departure from Normal	Total	Normal	Percent of Normal
Western Washington						
Olympia	44.5	43.2	1.3	6.23	8.21	76
Seattle WFO	46.1	46.4	-0.3	4.78	5.85	82
SeaTac AP	44.8	46.5	-1.7	5.78	6.31	92
Quillayute	46.9	44.7	2.2	12.79	15.26	84
Hoquiam	44.9	45.9	-1.0	9.06	10.95	83
Bellingham AP	42.5	44.5	-2.0	4.36	5.20	84
Vancouver AP	46.0	46.2	-0.2	5.01	5.51	91
Eastern Washington						
Spokane AP	36.5	36.3	0.2	1.89	2.06	92
Wenatchee	37.3	37.4	-0.1	0.82	0.85	96
Omak	37.6	35.9	1.7	1.25	1.24	101
Pullman AP	37.8	38.6	-0.8	2.25	2.14	105
Ephrata	37.3	37.6	-0.3	0.88	0.86	102
Pasco AP	39.9	40.9	-1.0	0.74	0.87	85
Hanford	39.7	40.3	-0.6	0.83	0.80	104

Table 1: November 2023 climate summaries for locations around Washington with a climate normal baseline of 1991-2020.

Climate Outlook

According to the Climate Prediction Center (CPC), a strong El Niño is present in the equatorial Pacific Ocean and an "El Niño Advisory" is in effect. Over the last month, above normal sea surface temperatures (SST) anomalies have strengthened, with anomalies exceeding 2°C in much of the central and eastern equatorial Pacific Ocean. ENSO models are certain that El Niño will persist through the winter of 2023-24; the chances of El Niño still around in the February-April period are 97% and that drops to 88% for the March-May period.

The CPC December temperature outlook (Figure 11) has slightly increased chances of above normal temperatures statewide. Odds are high that December precipitation will be above normal: in western WA, the chances of above normal precipitation are between 60 and 70% on the three-tiered scale. In eastern WA, the odds of above normal precipitation are between 50 and 60%. The odds are so high for the December forecast made on November 30 because short-term weather forecast models were already showing the atmospheric river we are currently experiencing in early December.

The December-January-February (DJF) temperature outlook (Figure 12) is also calling for higher chances of above normal temperatures statewide. Odds of above normal temperatures are between 50 and 60% across all of Washington. In contrast to the December outlook, DJF precipitation has equal chances being below, equal to, or above normal for the majority of the state. An eastern sliver of the state bordering Idaho has slightly elevated odds of below normal DJF precipitation.

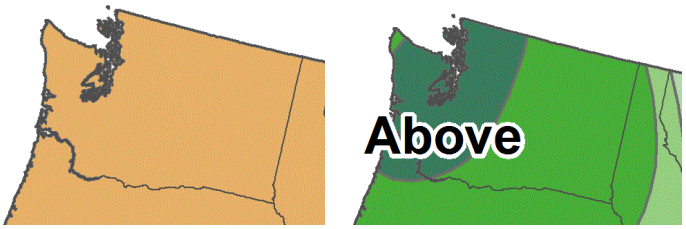
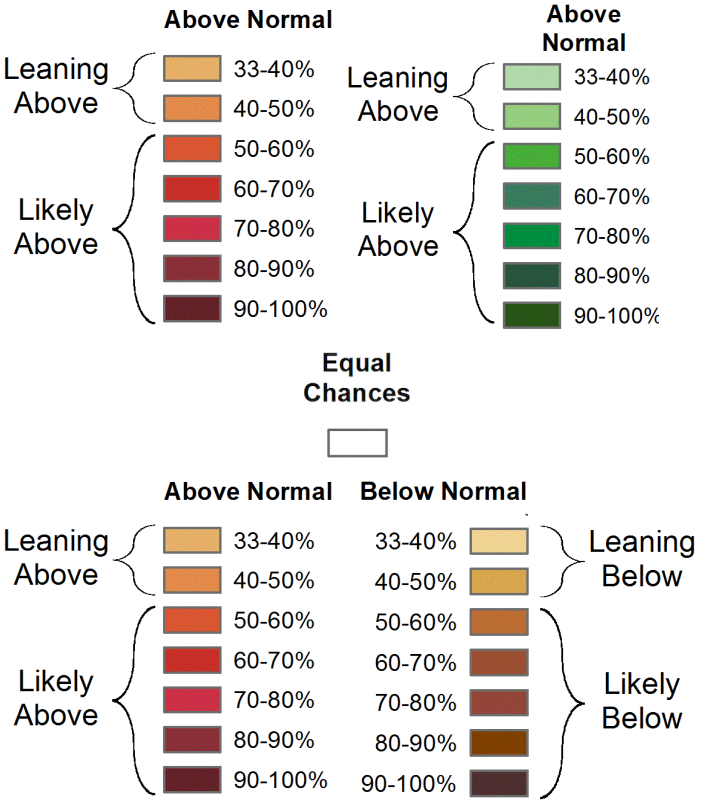


Figure 11: December outlook for temperature (left) and precipitation (right).



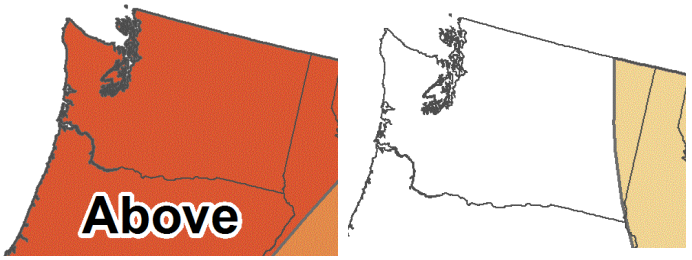


Figure 12: December-January-February outlook for temperature (left) and precipitation (right) (Climate Prediction Center).