Office of the Washington State Climatologist

June 2023 Report and Outlook

June 8, 2023

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

May Event Summary

Mean May temperatures were much greater than normal across the entire state, tying 1958 as the warmest May on record averaged statewide (+5.3˚F above the 1991-2020 normal). Table 1 shows May temperature rankings for a subset of Washington stations, many of which ranked among the top two warmest Mays on record. Figure 1 shows that nearly the entire state experienced temperatures in at least the top 10% category. There was more variability in total May precipitation, but a majority of the state received below normal precipitation, particularly the western and south central portions of the state. Averaged statewide, May ranked as the 15th driest, with -1.22" below the 1991-2020 normal.

The month began on a warm note, with a few days of above normal temperatures. Temperatures were closer to daily record values east of the Cascades (Figure 2) with a few daily maximum temperature records set, including at Spokane on the 2nd (85˚F) and 3rd (84˚F). While very little precipitation fell during May

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Station	May Average Temperature	Rank	Records Began
Spokane AP	63.5	1	1881
Quillayute	56.2	1	1967
Bellingham AP	59.1	1	1949
Vancouver Pearson AP	62.7	1	1998
Omak	66.4	1	1998
Wenatchee Pangborn AP	66.2	2	1960
Hoquiam	57.4	2	1953
SeaTac AP	60.9	2	1945
Olympia	58.6	2 (ties 1993)	1941
Ephrata	65.8	3	1949
Walla Walla	63.8	6 (ties 1994)	1949

Table 1: May 2023 average temperature rankings (warmest to coldest) for selected WA stations.

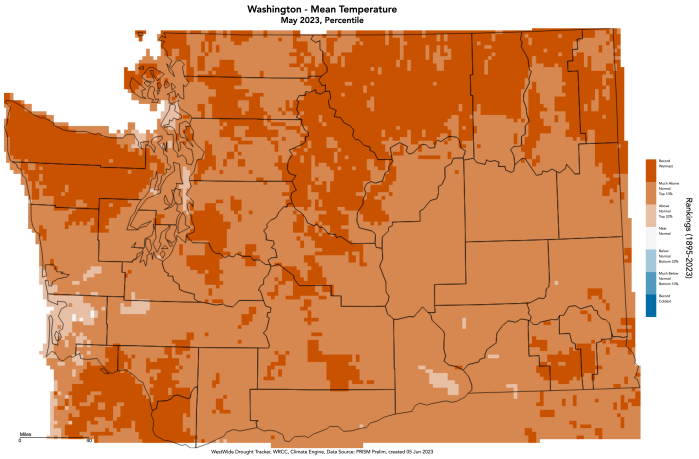


Figure 1: Mean May temperature percentiles compared to 1895-2023. The red categories go from "record warmest", to "top 10%", to "top 33%" from darkest to lightest (WRCC).

overall, most of what did fall occurred early in the month. SeaTac Airport had only 7 "rainy" days (>0.01") in May. It did record a maximum daily rainfall on the 5th of 0.70", which its highest daily total for the month. It also represents the greatest daily total during calendar year 2023 to date, which is a tribute to the overall precipitation deficits.

The most notable May weather event was the heat wave that began on the 12th in western WA. Offshore winds and a warm air mass helped break many daily temperature records before the ridge of high pressure moved east and contributed to record temperatures east of the Cascades. On the 12th through 15th, record high daily maximum temperatures were set at Olympia (85, 89, 90, 92°F) and SeaTac AP (82, 86, 89, 88°F), for example. Vancouver set daily high temperature records on the 12th (90°F) and 13th (93°F) and a daily record high minimum temperature on the 14th (58°F). For the month, Vancouver set a record with the most consecutive days 80 or above (9 days) and 90 or above (4 days), using a threaded station record going back to 1894. On the coast, both Quillayute and Hoquiam set high daily maximum temperature records on several days, and the high temperatures of 92°F and 91°F, respectively, on the 14th rank as the all-time highest May maximum temperature on record for each station.

Record high temperatures were set in eastern WA a little later in the month, with records set on the 19th and 20th at Spokane (87, 90°F), Wenatchee (91, 92°F), and Ephrata (93, 93°F), for example. Smoke also impacted the state during this time from wildfire that ignited in British Columbia and Alberta. Temperatures cooled into the normal range for portions of the second half of the month, but it was relatively short-lived. Precipitation was extremely limited to close out May.

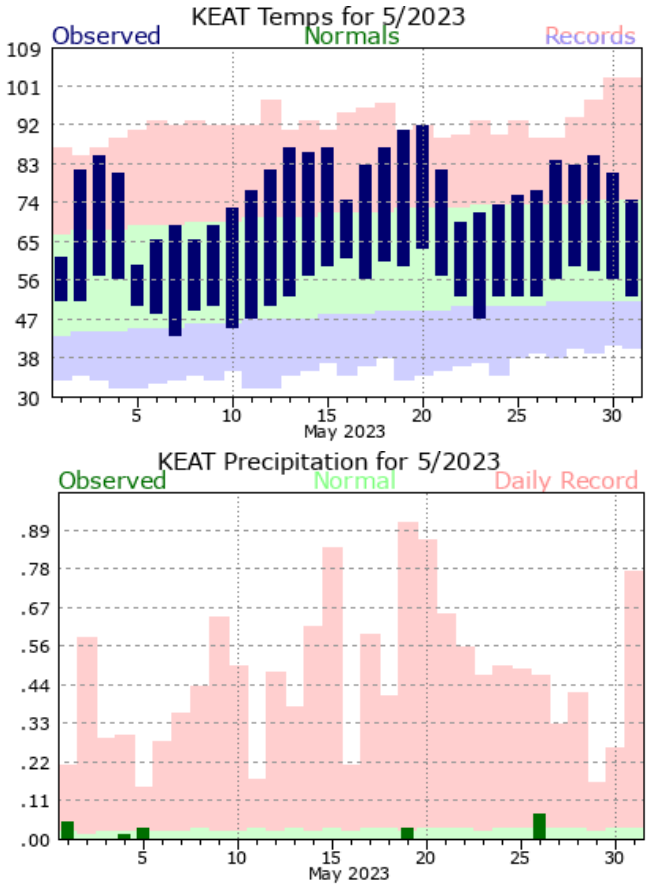


Figure 2: May 2023 daily temperatures for Wenatchee Pangborn Airport compared to the 1991-2020 normal (green envelope) and previous records (blue and red envelopes; NWS).

Snowpack and Drought Summary

With the switch to warmer and drier than usual conditions, and especially with the heat wave in mid-May, our snowpack did a disappearing act. Figure 3 shows the snow water equivalent (SWE) at the mountain SNOTELs as of June 1 from the Natural Resources Conservation Service. Most of the snowpack has melted out completely which isn't unusual for this time of year, especially east of the Cascade Mountains. But other sites on the Olympic Peninsula and western slopes of the Cascades, such as Stevens Pass (Figure 4), melted rapidly with the warm May temperatures, resulting in a snowmelt that was about two weeks earlier than usual in many locations. For this reason, streamflows were higher than usual in May for the snowmelt-dominated rivers in WA (Figure 5), and there was even some associated flooding in north central WA. With the earlier surge in streamflows, most rivers are now running below normal with the melt now mostly restricted to higher elevations.

The U.S. Drought Monitor (Figure 6) has responded to this shift in conditions with the expansion of "abnormally dry" conditions in both western WA and southeastern WA, and the introduction of "moderate drought" in western WA. The U.S. Bureau of Reclamation's revised June 5 forecast decreased the junior water rights water supply to 77% of their entitlements, down from the 86% projections in May. An updated forecast will be issued in mid-June. More on the Washington's water supply outlook can be found in a recent blog post from the WA Department of Ecology.

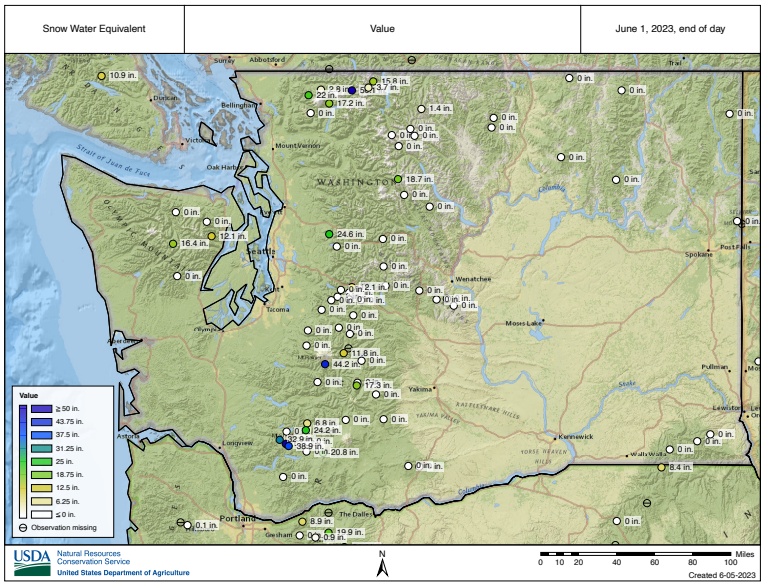


Figure 3: June 1, 2023 values of snow water equivalent in inches (from NRCS).

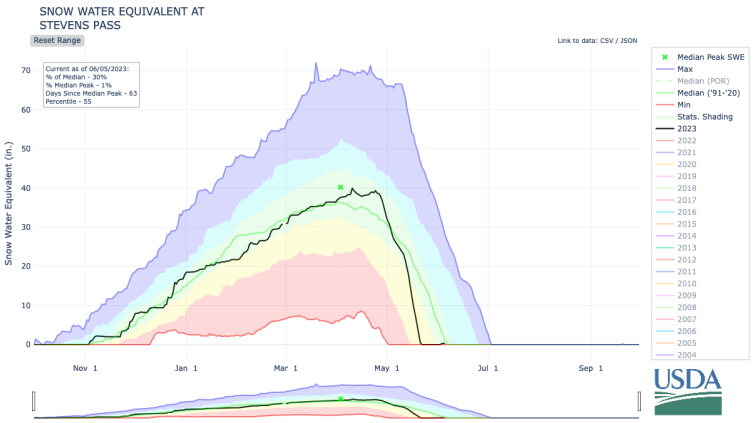


Figure 4: 2023 water year snow water equivalent (black trace) compared to median (green trace) and prior years, including the maximum (blue trace) and minimum (red trace), at the Stevens Pass SNOTEL site (NRCS).

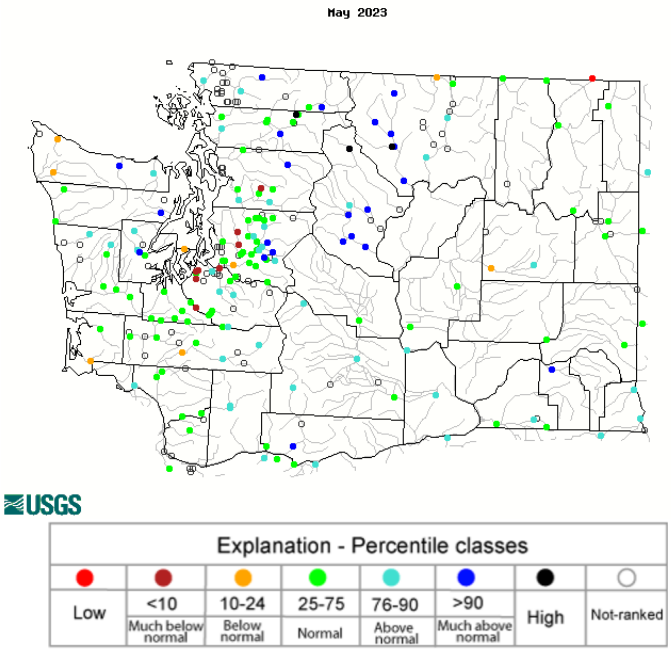


Figure 5: May 2023 average streamflow (USGS).

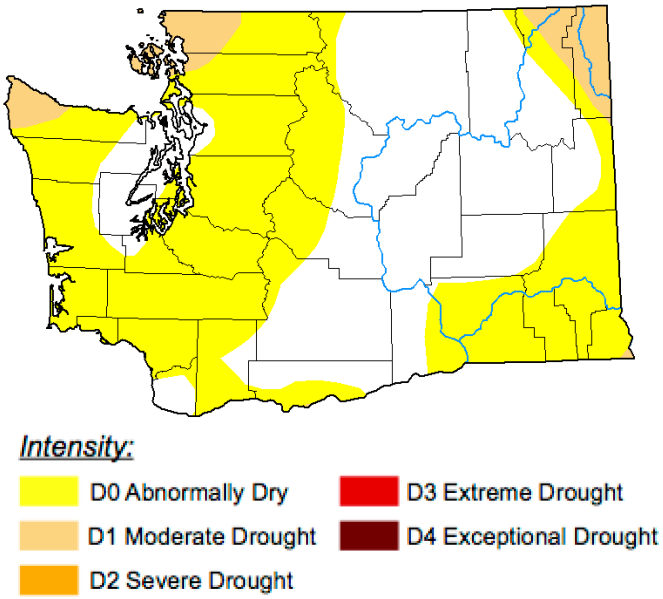


Figure 6: The June 8, 2023 edition of the U.S. Drought Monitor.

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 there's now a mobile app to make reporting easier!

Potential Evapotranspiration: Extreme Days in Eastern WA

A Message from the State Climatologist

This piece represents a follow-on to previous work focusing on summer seasonal mean trends in potential evapotranspiration (pET) in eastern Washington state (Bond and Bumbaco 2015). Our primary objective is to show how yearly counts of high pET days have varied since the late 1980s. The pET metric used here is the Kimberly-Penman (1982) formulation that has two terms: a "heat function" term combining the effects of the net radiative heating and sensible heat flux in the soil, and a "wind function" term representing the transfer of water vapor from the surface to the atmosphere due to the wind. Our survey is based on daily pET values from the Odessa, LeGrow and Lind stations maintained by the US Bureau of Reclamation AgriMet Network. Odessa is in northern portion of the Columbia Basin in a drier location with less irrigation in its vicinity; LeGrow is near the confluence of the Snake and Columbia Rivers with generally higher atmospheric humidity; Lind is located between the other two stations but with conditions more similar to those at Odessa.

We kick things off with an update on the seasonal mean time series of pET for Odessa, LeGrow and Lind (Figure 7), which were three of the stations featured in Bond and Bumbaco (2015). Seasonal mean values of pET for the years of 2013-2022 – our previous study used data through 2014 – for Odessa featured substantially higher values than earlier in the record, with 2017 being an especially high pET year. Lind has had a similar trend with 2015 being the top year. For LeGrow, the warm summer of 2015 represented also the record mean pET to date, but the overall increase in pET here is much more modest.

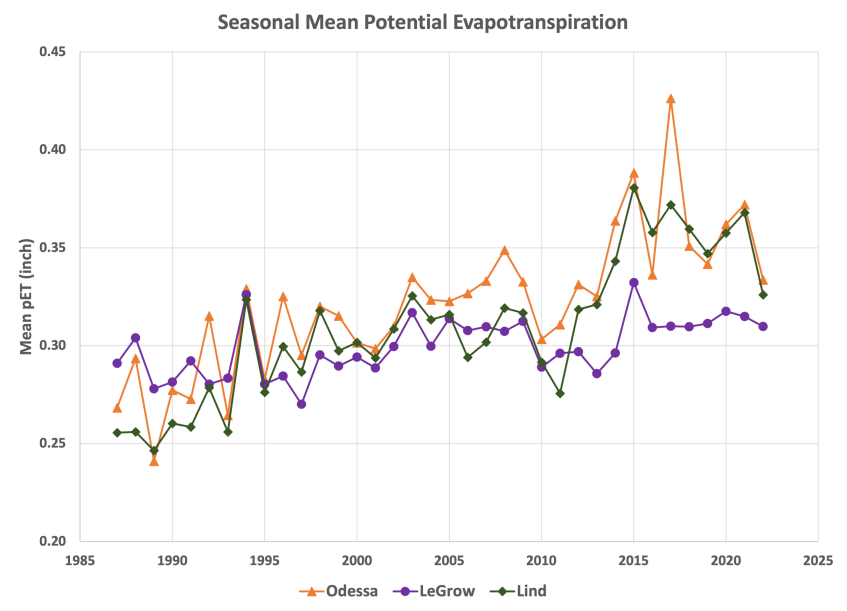


Figure 7: The summer mean pET from 1987 though 2022 for three stations in the AgriMet Network: Odessa (orange), LeGrow (purple), and Lind (green).

The instances of days with mean pET values at or above the arbitrary, yet relatively high, threshold of 0.45 inch at the three stations are shown in Figure 8, and we feel that the results are notable. There have been systematic if not monotonic increase in the number of drying (high pET) days over the last 20 years, and high pET days are almost completely absent before the turn of the century. Particularly extreme (>0.55 inch) days have occurred only during the past decade at Odessa and Lind; presumably they do not happen at LeGrow because of its greater humidity. It certainly can get hot in the Tri-Cities area.

The maximum pET day at Odessa (0.67 in) occurred on 21 August 2016 when the maximum temperature was a hot but not blazing 93°F; the mean dewpoint was just below 30°F with brisk winds meaning the wind function term in the pET dominated. The daily mean pET reached 0.69 inch at Lind on 30 July 2020 and 28 June 2021, with 31 July 2020 checking in right behind with 0.68 inch. The 2020 event included maximum temperatures above 100°F, moderately strong winds, and dewpoints in the upper 40s, with the later event also including high maximum temperatures in association with the severe PNW heat wave of 2021. The pET at Lind was actually higher on the day before the greatest maximum temperature of 115°F because the mean winds were stronger (though not quite the magnitude as observed during the July 2020 event). The pET at LeGrow was surprising small during the heat wave of 2021 with a peak value of 0.52 inch on 30 June when the maximum temperature was 110°F. The mean dewpoint temperatures were 10-20°F higher than at the other two stations and the wind speeds were considerably lower. We speculate that the cooler daytime temperatures, and much greater dewpoint temperatures, at LeGrow reflect the local effects of irrigation. Establishing that would require further analysis outside of the present scope.

We are struck by the prevalence of high pET days in the recent part of the historical record and plan to look more into the subject. For example, it would be informative to compare the typical (and range of) conditions associated with high pET days versus heat waves in that the overlap between these kinds of summer events is not complete. Conceivably high pET events can adversely impact crops in WA state, especially in situations when water delivery systems cannot keep up with shorter-term demands. If any of the readers of this newsletter have some insights on this topic we would like to hear from you.

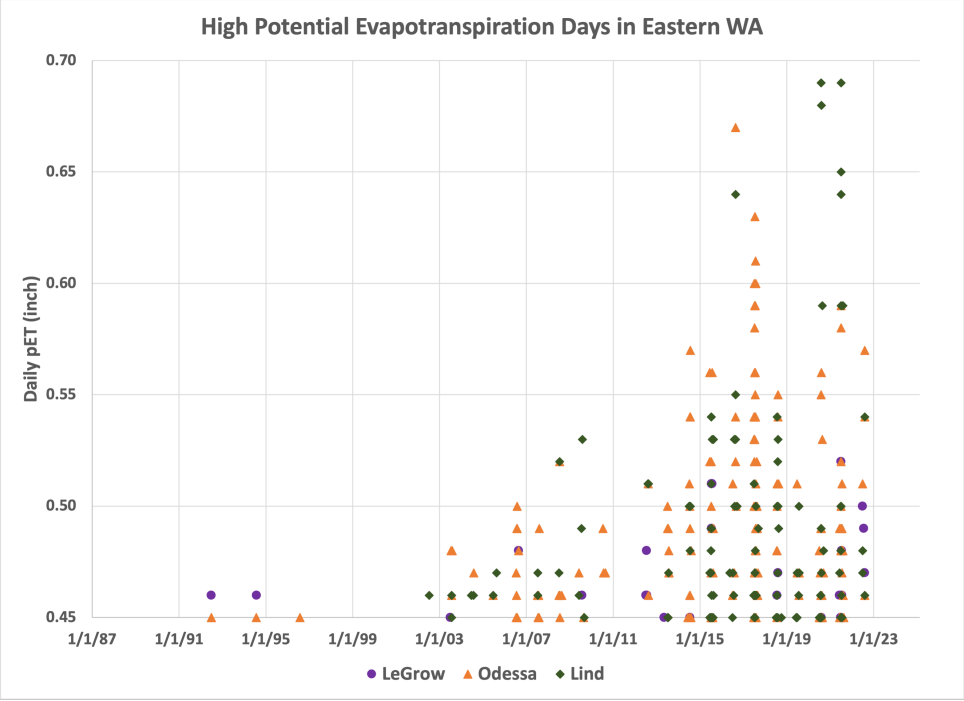


Figure 8: Summer days with mean pET above 0.45" at the three AgriMet stations from 1987 through 2022. Each column represents the high pET days in the summer following the date marker.

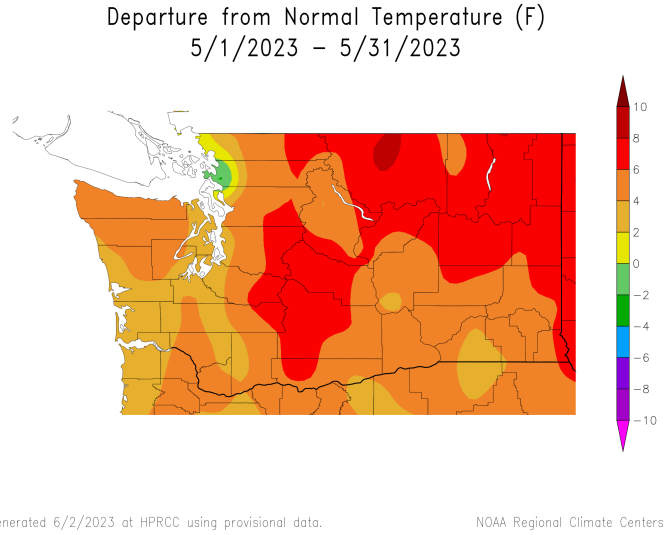
Reference

Bond, N.A. and K.A. Bumbaco (2015): Summertime Potential Evapotranspiration in Eastern Washington State, *J. Applied Meteorology and Climatology*, **54**, 1090-1101.

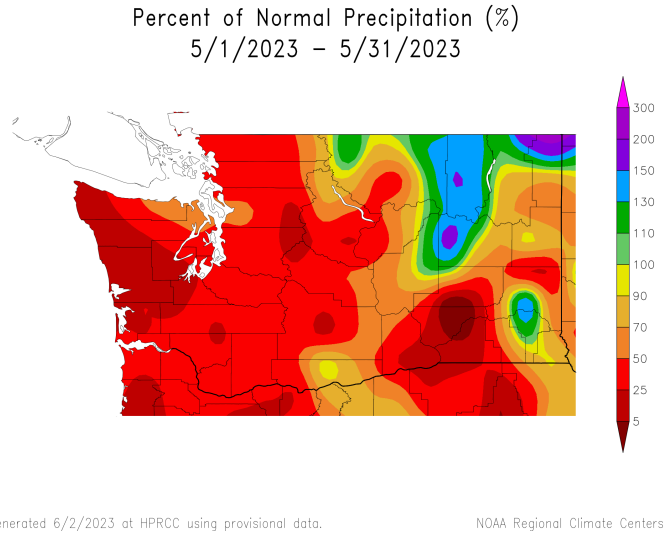
Climate Summary

Above normal May average temperatures are in contrast to the cooler than normal temperatures experienced over the last 3 months. According to the map from the High Plains Regional Climate Center, average May temperatures were between 4 and 8°F above normal for a majority of the state. Anomalies were larger in eastern WA, with Spokane and Omak an impressive 7.5 and 7.6°F above normal, respectively (Table 2). Temperature anomalies were not as large around the Puget Sound region compared to elsewhere in the state, but even those magnitudes were substantial. SeaTac Airport, for example, was 3.4°F above normal for the month (Table 2).

May precipitation was well below normal in western WA and parts of the Lower Columbia Basin where precipitation was between 5 and 25% of normal. Quillayute, for example, received only 11% of normal May precipitation, while Pasco had just 4% of normal (Table 2). There were exceptions. Spokane was drier than usual, but closer to typical May totals with 87% of normal. Parts of northeastern WA saw some thunderstorm activity, resulting in May precipitation totals between 110 and 200% of normal.



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



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

Station	Mean Temperature (°F)			Precipitation (inches)		
	Average	Normal	Departure from Normal	Total	Normal	Percent of Normal
Western Washington						
Olympia	58.6	54.5	4.1	0.59	2.26	26
Seattle WFO	60.4	56.8	3.6	0.88	2.16	41
SeaTac AP	60.9	57.5	3.4	0.93	1.88	49
Quillayute	56.2	51.7	4.5	0.47	4.25	11
Hoquiam	57.4	53.4	4.0	0.51	2.99	17
Bellingham AP	59.1	55.5	3.6	0.76	2.23	34
Vancouver AP	62.7	58.3	4.4	0.94	2.51	37
Eastern Washington						
Spokane AP	63.5	56.0	7.5	1.35	1.55	87
Wenatchee	66.2	60.1	6.1	0.19	0.77	25
Omak	66.4	58.8	7.6	0.53	1.19	45
Pullman AP	59.5	54.5	5.0	0.72	1.41	51
Ephrata	65.8	60.4	5.4	0.51	0.75	68
Pasco AP	67.2	61.4	5.8	0.03	0.71	4
Hanford	68.6	62.9	5.7	0.28	0.61	46

Table 2: May 2023 climate summaries for locations around Washington with a climate normal baseline of 1991-2020.

Climate Outlook

According to the Climate Prediction Center (CPC), El Niño is present and an "El Niño Advisory" is in effect as of June 8. Well above normal sea surface temperature (SST) anomalies in the far eastern equatorial Pacific Ocean have been present over the last 2 months, but have weakened slightly over the last month. Nevertheless, there is a larger area of above normal SSTs throughout the eastern equatorial Pacific Ocean. The atmospheric component of El Niño has also begun to emerge. ENSO models indicate that El Niño is likely to persist through the fall and winter; chances of El Niño next winter are at 96%.

The CPC June temperature outlook (Figure 9) has relatively high odds of above normal temperatures. Most of Washington has between a 60 and 70% chance of warmer than normal temperatures on the three-tier scale. Temperatures are likely to be above normal on the Olympic Peninsula and southwest Washington as well, with slightly lower odds of between 50 and 60%. June precipitation is uncertain for western Washington and the northern Cascades with equal chances of below, equal to, or above normal precipitation. Odds are elevated for above normal June precipitation throughout most of eastern Washington.

The three-month summer (June-July-August; JJA) temperature outlook is similar to the June outlook and is calling for increased chances of above normal temperatures statewide (Figure 10). Odds of above normal temperatures are slightly higher for eastern Washington. The summer precipitation outlook indicates slightly increased chances of below normal precipitation statewide.

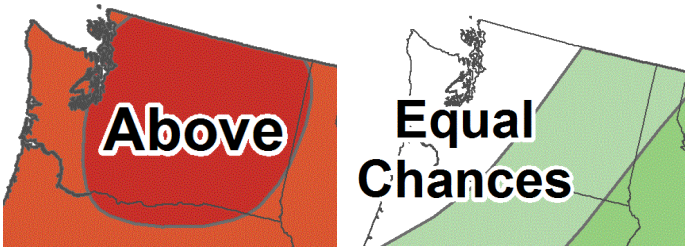


Figure 9: June outlook for temperature (left) and precipitation (right).

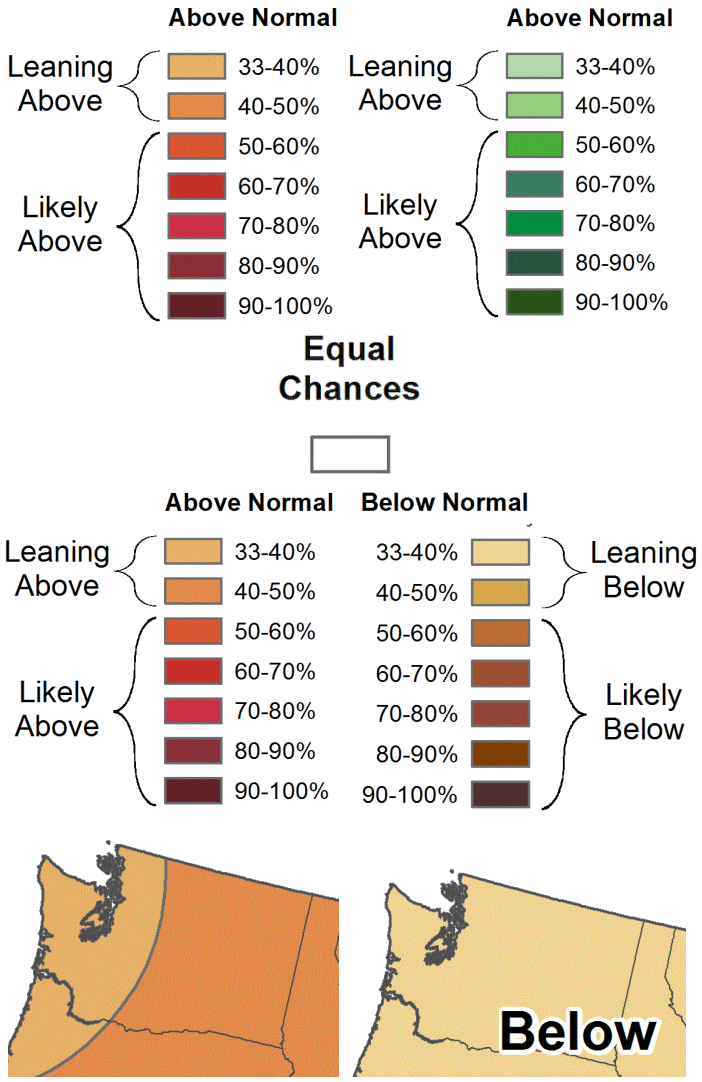


Figure 10: June-July-August outlook for temperature (left) and precipitation (right) (Climate Prediction Center).