Office of the Washington State Climatologist

October 2022 Report and Outlook

October 11, 2022

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

September Event Summary

Mean September temperatures were above normal statewide. Averaged statewide, the month ranked as the 5th warmest September on record (+3.3˚F above the 1991-2020 normal). Table 1 shows September temperature rankings for some individual stations in WA, all of which have the month among the top 10 warmest. September precipitation was below normal for nearly the entire state with some notable exceptions along the Washington/Idaho border. Even with some wetter areas, the month tied 1943 as the 11th driest September on record when averaged across the state. Western WA was especially dry relative to normal, with many locations experiencing about the 8th driest September on record. Bellingham was even drier; the "trace" of precipitation tied 2012 as the driest September on record.

The month started on a warm note, with several stations in eastern WA setting high temperature records during the first several days. For example, on the 1st, Pasco (102˚F), Dallesport (102˚F - tie), and Ellensburg (96˚F) set daily high maximum temperatures. The 102˚F at Pasco also ranks as the highest September maximum temperature in the 78-year record. Western WA had its turn for

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record high daily maximum temperatures on the 10th; Quillayute (92˚F), SeaTac (92˚F), and Hoquiam (91˚F) all set daily records. That day was

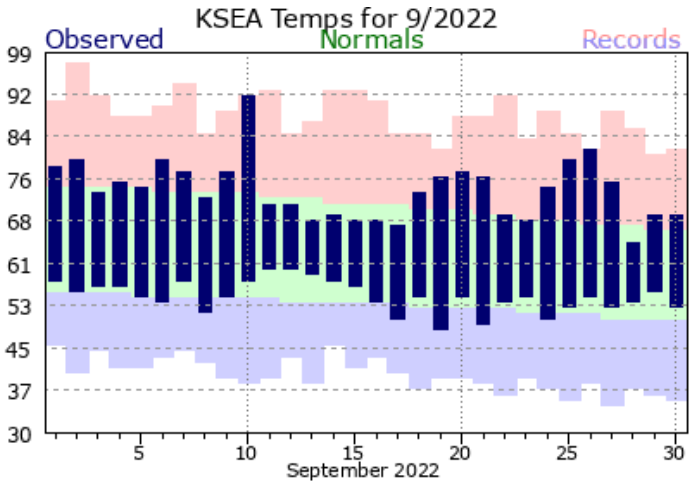


Figure 1: September 2022 daily temperatures for SeaTac Airport compared to the 1991-2020 normal (green envelope) and previous records (blue and red envelopes; NWS).

particularly windy, as a gusty downslop flow from the east made for dangerous fire weather conditions. The Bolt Creek Fire near Skykomish started on the 10th, and was responsible for poor air quality in Seattle at times throughout the month extending into October.

There was a moderate cool down in temperatures in the middle of the month (Figure 1) when conditions were more seasonal and light precipitation fell. Yakima, for example, set a maximum daily rainfall record — albeit with a mere 0.05" — on the 13th. But Wenatchee recorded a more substantial 0.52", accounting for most of the monthly total at that station.

Station	September Average Temperature (°F)	Rank	Records Began
Omak	67.0	1	1998
Spokane AP	65.5	3	1881
SeaTac AP	64.8	3	1945
Bellingham AP	61.3	3	1949
Pullman 2 NW	63.7	5	1941
Quillayute	60.2	5	1966
Yakima AP	65.3	5 (tie)	1946
Olympia	62.1	8	1941
Wenatchee Pangborn AP	67.8	7	1960

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

Temperatures were back above normal for most of the remainder of the month. More record high daily maximum temperatures were set on the 26th at Dallesport (93°F - tie), Olympia (86°F), Ellensburg (86°F), SeaTac (82°F), and Bellingham (79°F - tie). On the 27th, Spokane (90°F) and Omak (89°F - tie), and Ellensburg (88°F - tie) set daily high maximum temperatures records as well.

A small glimmer of fall was in sight at the end of the month when precipitation fell in southeastern WA and along the Idaho border. Both Spokane (0.46") and Pullman (1.25") set maximum rainfall records on the 29th.

Finally, we close with a summary of the July-September conditions (Figure 2). Averaged statewide, July-September ranks as the warmest such period in the 128-year record, with anomalies 3.5°F above normal. The warmer than normal temperatures were experienced throughout the state while the precipitation anomalies were more variable. For example, western WA only saw between 10 and 30% of normal precipitation while eastern WA varied from 10 to near-normal (110%). Averaged statewide, total July-September precipitation still ranks as the 2nd driest on record, with a scant 36% of normal.

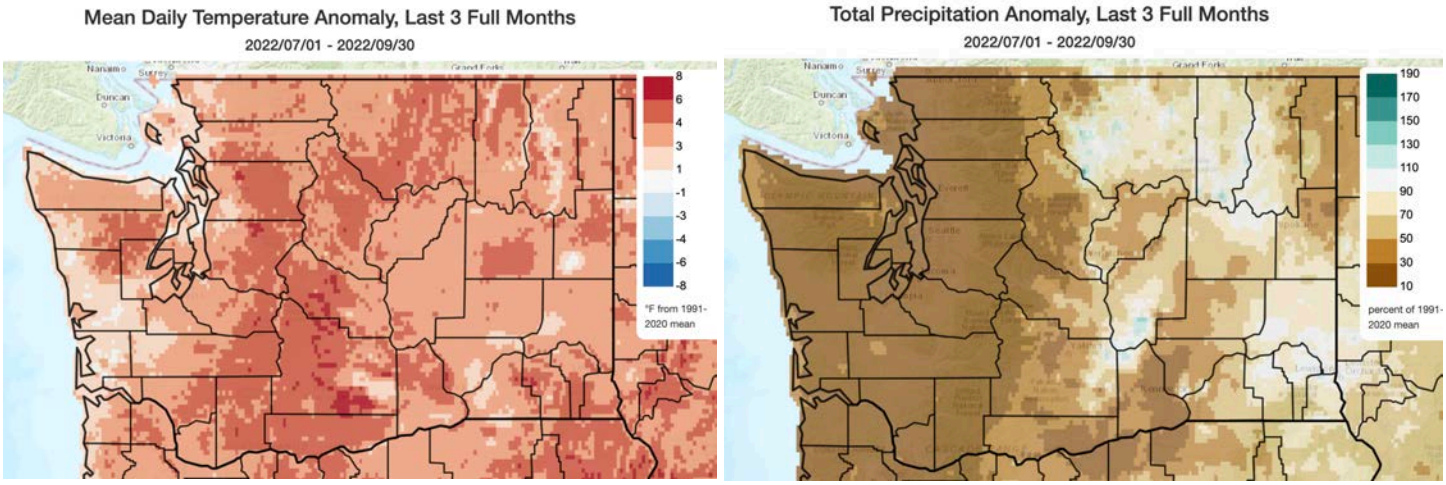


Figure 2: July-September average temperature departure from normal (left) and precipitation percent of normal (right). (Climate Toolbox)

Streamflow and Drought Summary

Due to the persistence in our warmer and drier than normal conditions, streamflows have responded throughout the state. Average September streamflow were at record lows for some rivers across western WA (Figure 3). For example, gauges on the Hoh, Skokomish, Quinault, and Skookumchuck Rivers all measured September average flows at the 1st percentile. Record lengths vary, but are generally at least 50 years.

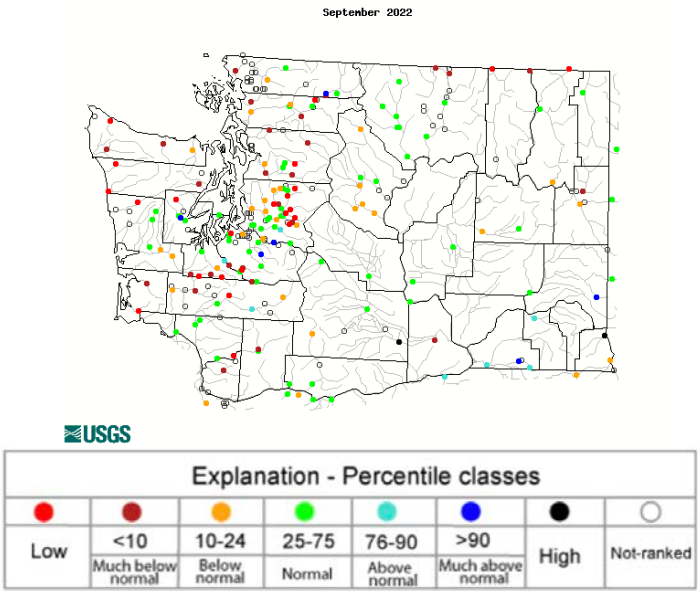


Figure 3: September 2022 average streamflow for WA (USGS).

The continued dry and warm conditions, along with low streamflows and drying soils, have prompted additional drought expansion on the U.S. Drought Monitor (Figure 4). In addition to longer-term dryness reflected in the U.S. Drought Monitor for many months, the short-term dry signals are also now represented in the depiction. All of WA is now in at least "abnormally dry" conditions, and the areas of "moderate drought" have been expanded in eastern WA and added to western WA.

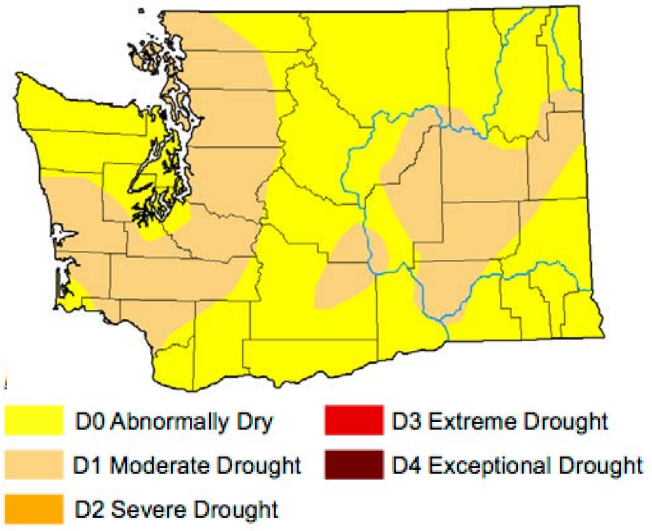


Figure 4: The October 4, 2022 edition of the U.S. Drought Monitor.

Timing of Seasonal Changes in the Weather of Washington State

A Message from the State Climatologist

This corner of our newsletter has recently concerned the seasonality of weather events in Washington state, and we continue in a similar vein in the present edition. More specifically, we consider average changes in temperature and mean precipitation on a daily time scale over the course of the year for selected locations in Washington. The autumnal equinox is in the rear-view mirror, of course, and so it is officially fall based on the astronomical definition. On the other hand, the "meteorological" fall is often considered to begin on 1 September, with the other meteorological seasons also 3 weeks ahead of their astronomical counterparts. What definition actually makes the most sense given the observed weather in the state? Moreover, are our seasons symmetrical, i.e., each 3 months in duration from a weather – not day length – perspective? Here's your chance to find out.

The present analysis is based on daily mean temperature and precipitation amounts for the years of 1991 through 2020 at four locations: Hoquiam (HQM), Sea-Tac (SEA), Tri-Cities, and Spokane (GEG). The mean temperatures and precipitation totals for each calendar date were subject to 15-day running-mean averaging to reduce the day-to-day variability associated with high-amplitude events that are reflected as noise in the 30-year means. Greater and lesser smoothing was explored with the single 15-day averaging appearing to strike a reasonable balance between filtering out much of the more or less random fluctuations while retaining meaningful seasonal trends on shorter time scales. For the temperature records, we also computed 15-day best-fit linear trends for each calendar date to better highlight the changes in average temperature over the course of the year. The results for temperature and precipitation are shown in Figures 5 and 6, respectively.

The temperature trends on a 15-day time scale over the course of the year (Figure 5) are worth staring at for a while. Note that the rates of warming early in the year and of cooling late in the year are much greater east of the Cascades in the Tri-Cities and Spokane, as expected given their more continental influences. What is a bit of a surprise is the coincidence in the transition from warming to cooling at the very end of July at three out of the four stations, with Hoquiam lagging by about 2 weeks (based on an eyeball smoothing of its trace). This lag makes sense given the thermal inertia of the ocean, which continues to warm later into the year. It also is interesting that all four stations stop cooling essentially at the end of the calendar year. In other words, there is warming in January, albeit not at the rate that occurs in a couple of months. The period of greatest warming, which could be the basis for defining "spring", occurs from the beginning of March through June and hence is arguably 4 months in duration. By way of comparison, the pronounced cooling of fall is compressed into something more like 2 to 3 months. Figure 1 indicates there is usually marked cooling in early October in stark contrast with the present year, which features a summer that refuses to end.

Normally, we would also be experiencing periods of significant rain, as illustrated by the

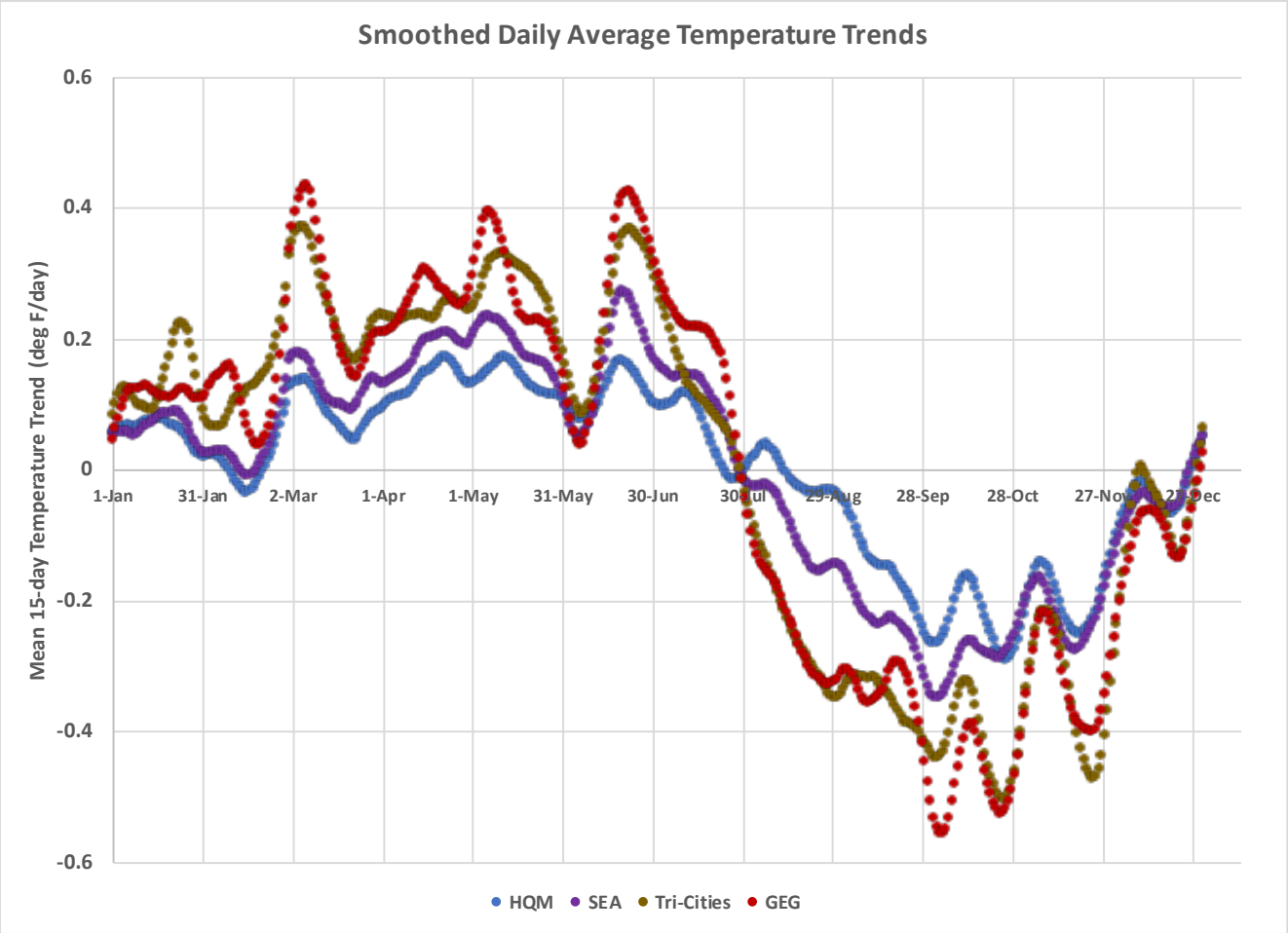


Figure 5: Temperature trends on a 15-day time scale over the course of the year for Hoquiam (HQM), Sea-Tac (SEA), Tri-Cities, and Spokane (GEG). Daily data are averaged using 1991 through 2020 for each station.

precipitation time series of Figure 6. Daily average amounts really ramp up over the course of October; we are liable to get into a more typical weather pattern before too long, so consider yourself forewarned. At least for Sea-Tac and Spokane, it can be argued that the increase in precipitation ("fall") occurs typically over an interval of 2 months (October and November). The period of decrease in precipitation west of the Cascades (at least at HQM and SEA) is from near the start of the calendar year into July, and by this measure "spring" is about 6 months long! The decreases in precipitation during the first half of the year are not nearly as marked in the Tri-Cities or Spokane. Those two locations happen to have local maxima in their mean daily precipitation from early May into June. Spokane has actually received slightly more precipitation than Sea-Tac during some days in late May for the 30-year period considered here.

To address our question of meteorological vs. astronomical fall posed in the introduction, we can have it both ways in Washington state. According to these 4 stations, it appears as if September 1 is a better fall definition for western WA while astronomical fall is a better definition for eastern WA. HQM and SEA have more distinct temperature drops and precipitation increases in September compared to their

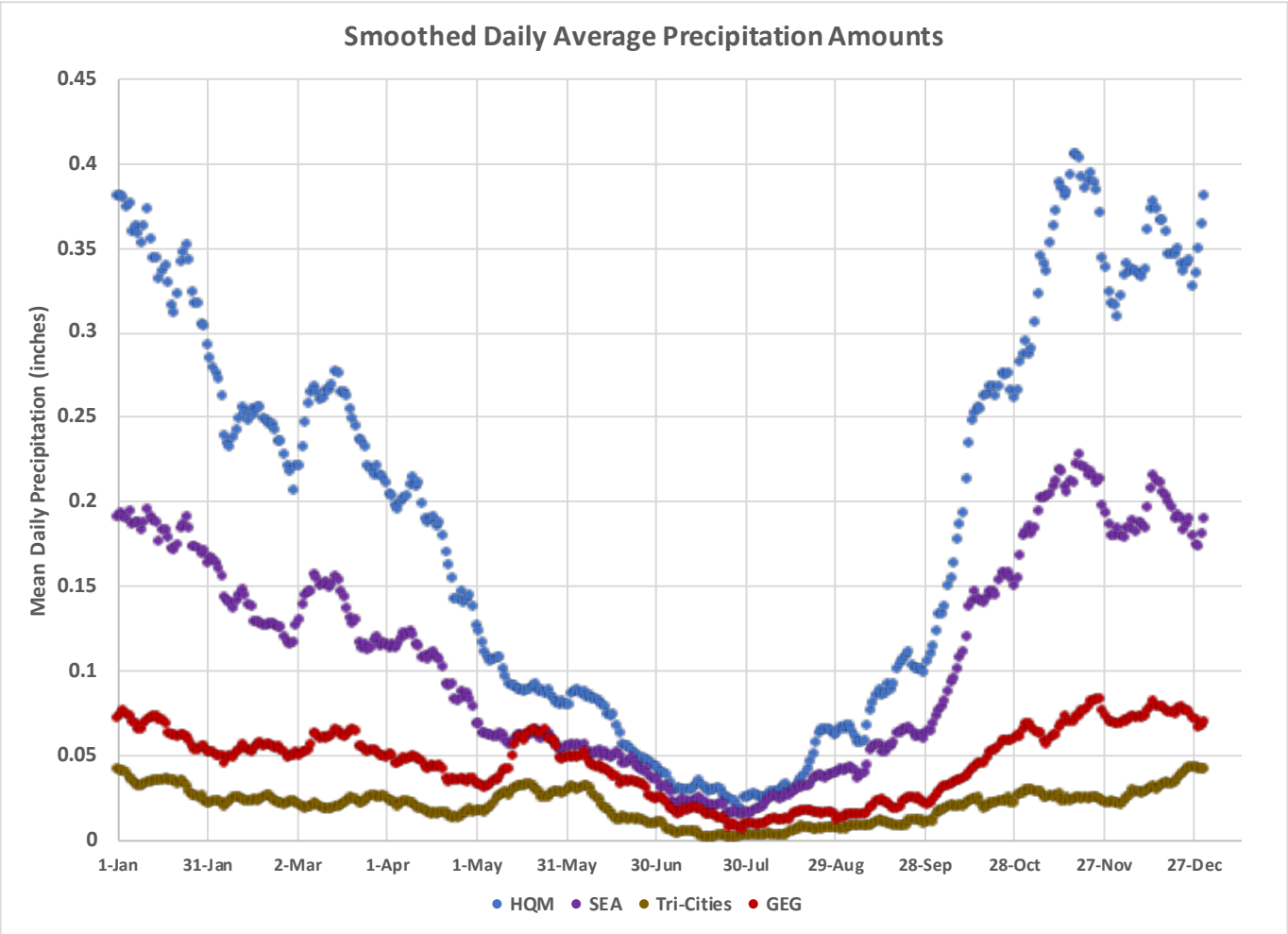


Figure 6: A smoothed daily precipitation time series for Hoquiam (HQM), Sea-Tac (SEA), Tri-Cities, and Spokane (GEG). Daily data are averaged using 1991 through 2020 for each station.

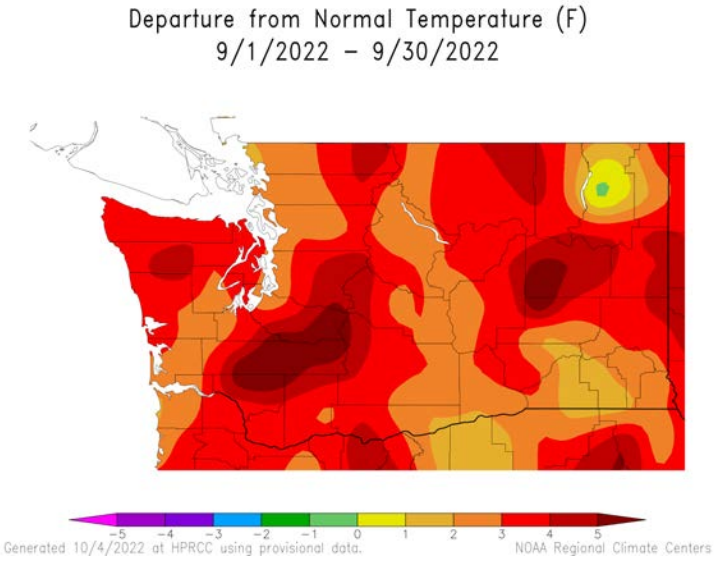
counterparts in eastern WA, where the change happens closer to the end of September and early October.

It is outside the scope of the present piece, but it would be interesting to determine the extent to which the seasonality of the temperature and precipitation in WA have changed over the historical record. Attribution of such changes gets tricky given the natural variability on decadal time scales. The global climate models as a group are suggesting that the future climate of WA will include wetter winters and drier summers in an overall sense, and so you will want to check this space down the line, say 30 years from now, to see if those projected changes are coming to fruition.

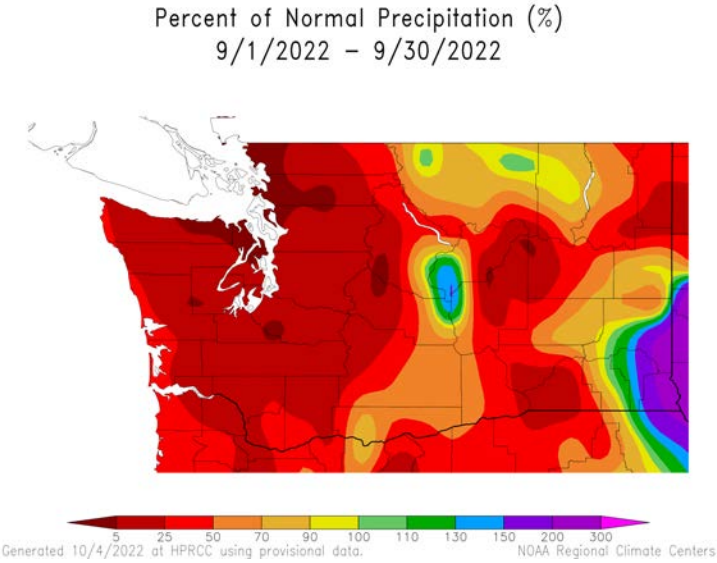
Climate Summary

Average September temperatures were above normal statewide, as shown in the plot from the High Plains Regional Climate Center. Temperature anomalies were between 2 and 4°F for most of the state (Table 2), though there were some warmer exceptions. Spokane, for example, was 4.4°F above normal for the month. This marks the third consecutive month in which temperatures were warmer than normal statewide.

Total September precipitation was below normal for most of the state. Totals were particularly minimal in western WA; since precipitation typically ramps up in September, the meager amounts only represented between 5 and 25% of normal (Table 2). Bellingham was especially dry, receiving just a "trace" of precipitation all month. In eastern WA, Ephrata was similarly dry, though September "traces" are more common in that location. Precipitation was below normal throughout most of eastern WA as well, though there were exceptions. Wenatchee and Pullman received 235 and 272% of normal, respectively, due to heavy rain events on the single days of the 13th and the 29th, respectively.



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



September 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	62.1	59.1	3.0	0.13	2.04	6
Seattle WFO	65.4	62.3	3.1	0.13	1.74	7
SeaTac AP	64.8	62.6	2.2	0.25	1.61	16
Quillayute	60.2	57.1	3.1	1.12	4.56	25
Hoquiam	63.2	59.1	4.1	0.75	2.53	30
Bellingham AP	61.3	58.9	2.4	T	2.01	0
Vancouver AP	67.8	63.9	3.9	0.53	1.43	37
Eastern Washington						
Spokane AP	65.5	61.1	4.4	0.53	0.58	91
Wenatchee	67.8	64.6	3.2	0.54	0.23	235
Omak	67.0	63.3	3.7	0.26	0.40	65
Pullman AP	62.0	59.8	2.2	1.77	0.65	272
Ephrata	67.9	64.5	3.4	T	0.22	0
Pasco AP	67.9	64.2	3.7	0.12	0.31	39
Hanford	69.8	67.1	2.7	0.17	0.23	74

Table 2: September 2022 climate summaries for locations around Washington with a climate normal baseline of 1991-2020.

Climate Outlook

La Niña conditions are present in the Pacific Ocean and a "La Niña Advisory" remains in effect, according to the Climate Prediction Center (CPC). Over the last 4 weeks, below normal sea surface temperature (SST) anomalies have strengthened in the eastern equatorial Pacific Ocean. La Niña is expected to continue through this fall and is favored through the winter as well. According to ENSO models, there is a 65% chance of La Niña for the October through December period compared to 33% for neutral conditions and 2% for El Niño.

The CPC outlook for October (Figure 7) indicates a higher likelihood of above normal temperatures statewide. The probability of above normal temperatures is higher for the southeastern portions of the state. The precipitation outlook has shifted from the October outlook released in mid-September, and now has equal chances of below, equal to, or above normal precipitation. In other words, despite the dry start to the month, total October precipitation is uncertain.

The three-month outlook for October-November-December (OND) shown in Figure 8 lacks a signal for temperature. Average temperatures over OND may be below, equal to, or above normal throughout the state. Precipitation, on the other hand, is likely to be above normal for OND statewide.

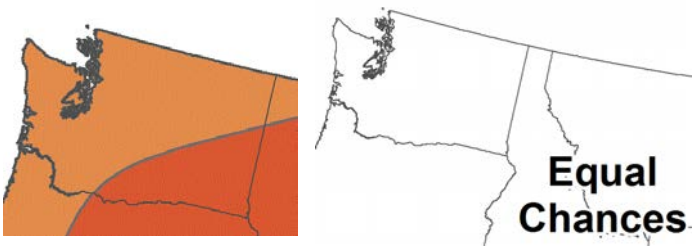


Figure 7: October outlook for temperature (left) and precipitation (right).

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