Office of the Washington State Climatologist

June 2019 Report and Outlook

June 6, 2019

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

May Event Summary

Mean May temperatures were above normal for nearly the entire state, with temperatures mostly between 2 and 4°F above normal. Averaged statewide, May 2019 tied as the 9th warmest May on record (since 1895). Precipitation, on the other hand, was quite variable with western WA and northeastern WA receiving much below normal precipitation and parts of eastern WA receiving above normal precipitation. The above normal precipitation in eastern WA occurred over only a few days mid-month and over Memorial Day weekend; Figure 1 shows an example for Omak which also happened to set two daily rainfall records on the 16th (1.32") and the the 25th (0.57").

The first half of May was generally warmer than normal, with temperatures peaking between the 8th and 10th in western WA and between the 10th and 12th in eastern WA before marine air cooled temperatures to near-normal. On the 9th, Quillayute (84°F), SeaTac AP (83°F), and Hoquiam (83°F) set daily record high temperatures. Bellingham measured a daily record high of 81°F on the 10th. Temperatures were generally in the 80s in eastern WA during this time, but not warm enough to set daily records.

In this Issue

Temperatures cooled mid-month and some precipitation moved in. Eastern WA was affected more by the precipitation as there were some heavy rain showers and thunderstorms that popped up with even some urban flooding. A daily

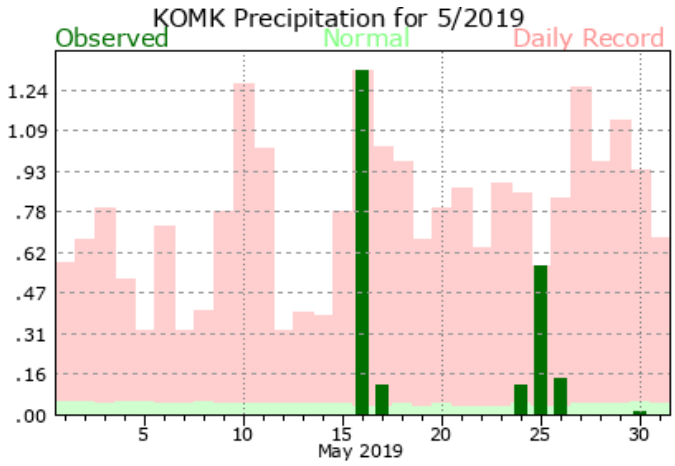


Figure 1: Daily May precipitation for Omak compared to normal (green envelopes) and historical records (red bars). NWS

rainfall record was set on the 16th at Omak (1.32”), Ephrata (0.50”), and Wenatchee Airport (0.21”). More precipitation fell in eastern WA over Memorial Day weekend in the form of showers and thunderstorms that moved from the southeast to northwest across the region. Omak again set a record daily rainfall (0.57”) on the 25th.

Figure 2 shows the temperature and precipitation percentiles for the spring (March through May), indicating a substantial contrast between western and eastern WA. Spring in western WA was warmer and much drier than normal while parts of eastern WA were cooler than normal with near-normal precipitation. Still, averaged statewide, spring was the 13th driest on record (-3.21” below normal). Table 1 shows spring precipitation rankings for some individual stations in western WA. Spring temperatures, on the other hand, were about normal from a statewide perspective.

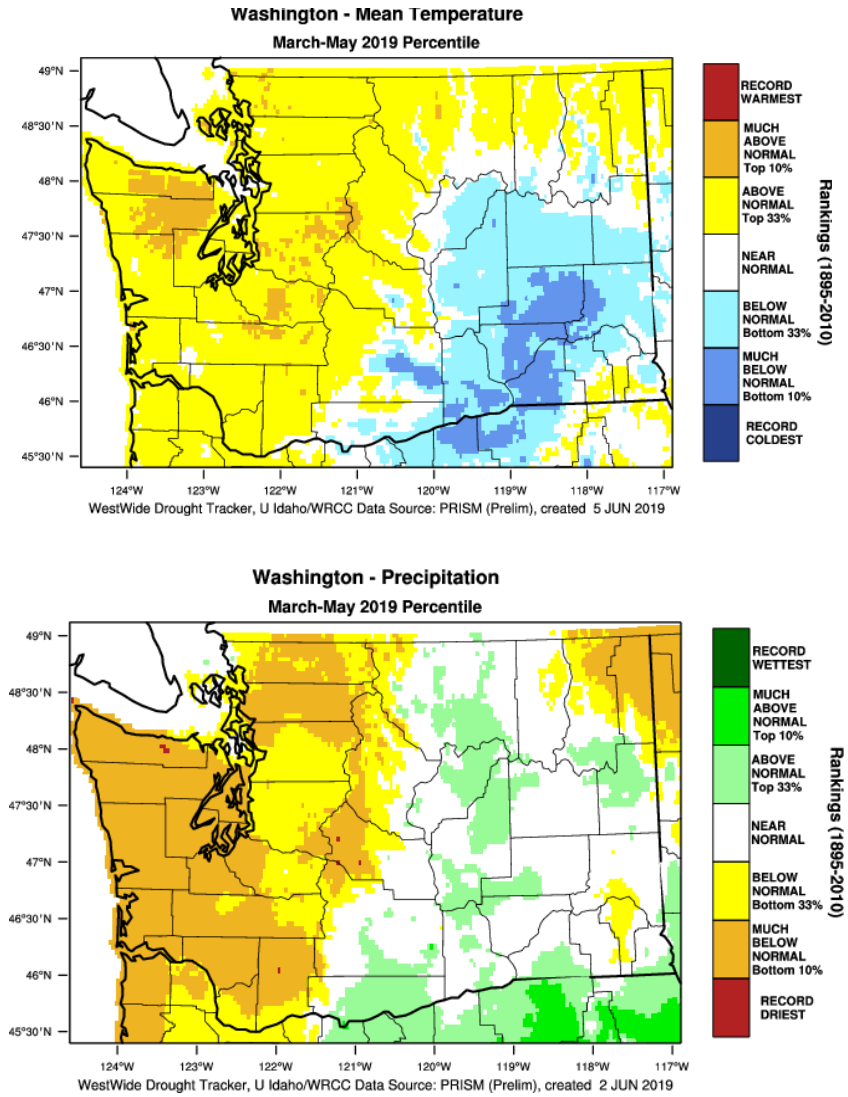


Figure 2: May 2019 temperature (top) and precipitation (bottom) percentiles compared to the 1895-2010 historical record (WWDT).

Station	MAM Precipitation (in)	Rank	Record (Precipitation/ Year)	Records Began
Quillayute	10.58	1	-	1966
Olympia	4.97	1	-	1942
Hoquiam	7.44	1	-	1953
SeaTac AP	5.52	8	3.24”; 1979	1945

Table 1: May 2019 precipitation, the ranking (driest to wettest), the record, and year that records began for selected stations.

Snowpack and Drought Update

The warm May temperatures contributed to relatively rapid melt of our mountain snowpack. Most of our snowpack has melted 2-3 weeks early resulting in very low June 1 basin average snow water equivalent (SWE) percentages of normal. Figure 3 instead shows the very few Snotel sites that have snow water equivalent left as of June 1; the white circles have all melted out. Figure 4 shows an example plot from Stevens Pass indicating that the snowpack melted about 2 weeks earlier than usual (dark blue line).

The current U.S. Drought Monitor map (Figure 5), taking the recent precipitation deficits, low streamflows, and below normal soil moisture into account, now shows "moderate drought" (D1) throughout all of western WA with a large area of "severe drought" (D2) on the coast and Olympic Peninsula. The Drought Monitor depiction has changed little for eastern WA since our last newsletter.

Using the state's definition of drought (projected water supply below 75% of normal and expected hardship) Governor Inslee declared 24 more watersheds in drought on May 20. More information and a map of the declared areas can be found at the Department of Ecology's drought page.

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 has developed a Drought Impact Reporter that allows the public to enter their observations regarding crops, water supply, fire, etc. in a short survey and we would appreciate your input.

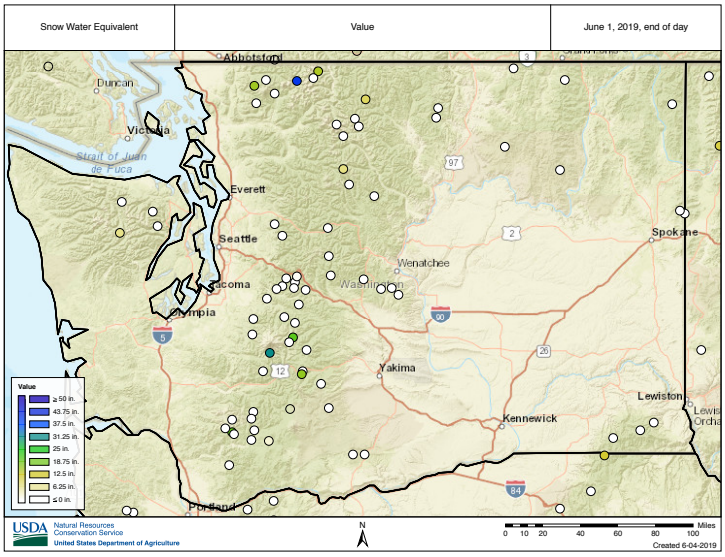


Figure 3: Values of snow water equivalent (SWE; inches) in WA as of 1 June 2019 (NRCS).

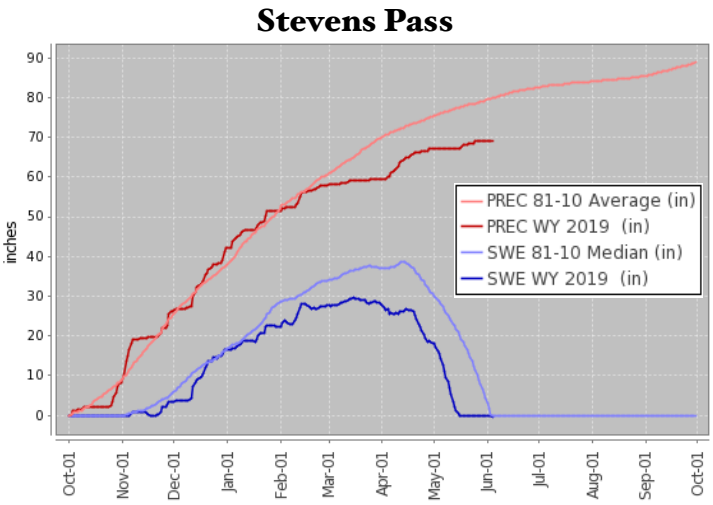


Figure 4: 2019 water year accumulated SWE (dark blue) compared to normal (light blue) for Stevens Pass.

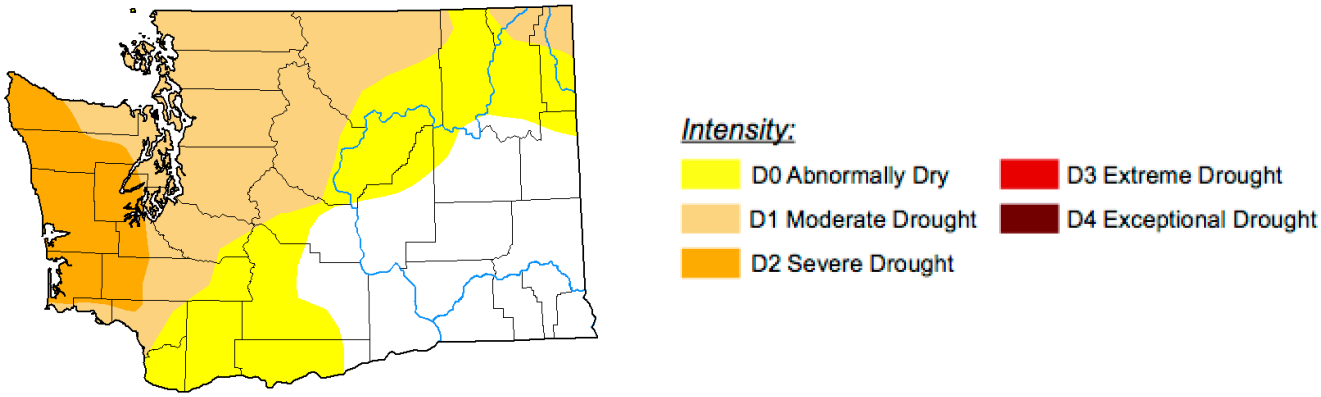


Figure 5: The 6 June 2019 edition of the US Drought Monitor.

Humidity Variations during Heat Waves in WA State

A message from the State Climatologist

Summer is approaching, and while there will surely be some spells of hot weather, we cannot say much about their severity. Our most extreme heat waves tend to occur in July and August, but they certainly can occur earlier in summer and occasionally well into September. People that are outside and active for extended periods such as agricultural and construction workers are particularly exposed to this weather hazard; the heat stresses they endure are related to not just temperature but also the humidity. The purpose of this piece to show how much the latter can vary over short distances.

A picture is worth a thousand words and towards that end shown here are a pair of maps with measurements collected during the extreme heat wave that occurred in eastern WA near the end of June 2015. Maps were made with a rather slick app maintained by NOAA's National Operational Hydrologic Sensing Center.

Focusing on the Yakima Valley and Columbia Basin, the station observations of air temperature and dewpoint at 2300 UTC (4 pm local time) on 28 June 2015 are shown in Figures 1a and 1b, respectively. This was the hottest day of the event, with the 113°F at Walla Walla and Chief Joseph Dam setting the warmest June temperature on record for anywhere in the state. While there were spatial variations in air temperature during this blistering-hot afternoon, they were dwarfed by those in dewpoint, which ranged from the mid-40s to 70°F at this time of day. Similar results featuring larger variations in dewpoint than in air temperature were found for the afternoon of 10 August 2018 during one of the hottest days last summer. The large differences in humidity presumably relate to local surface conditions and especially whether a source of moisture is directly upwind. The region includes a patchwork of dryland and irrigated fields, and evapotranspiration from the latter can be a significant source of atmospheric humidity. Conceivably the spatial patterns in summertime humidity are more-or-less systematic, but we have not carried out the kind of analysis required to determine the extent to which that is the case. It would seem worthwhile to do so because the heat stress experienced by humans (and livestock)

depends to a great deal on these kinds of variations in humidity.

The wet-bulb globe temperature (WBGT) is a widely-used measure of the threat of heat stress for individuals exposed to direct sunlight. The WBGT is a function of the air temperature, humidity, wind speed and solar radiation and can be estimated using a widget provided by the National Weather Service (NWS) forecast office in Tulsa, OK. Using values representative of the late June 2015 heat wave, and with all other parameters held constant, the WBGT was 82°F where the dewpoint was 45°F and 89°F where the

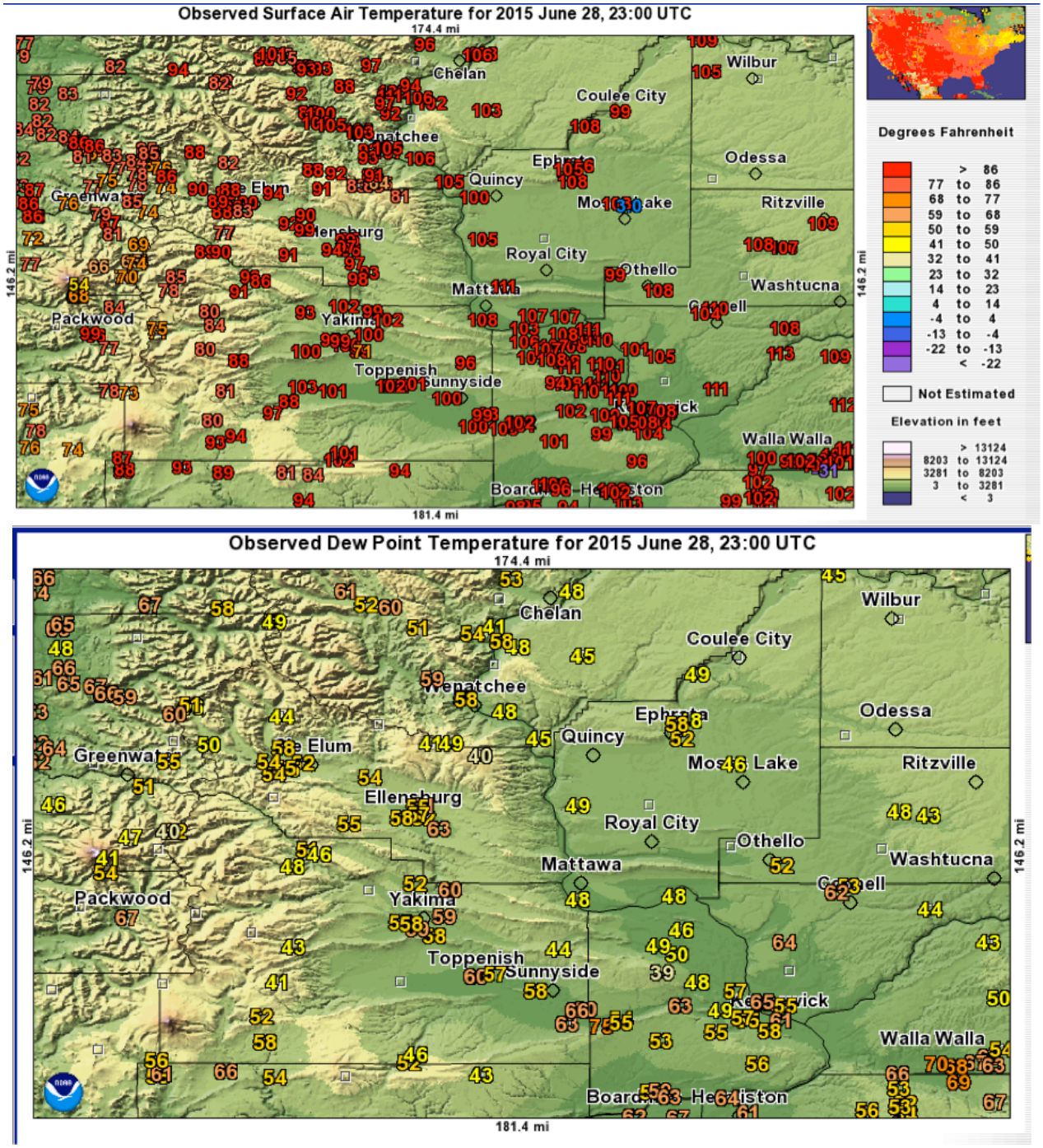


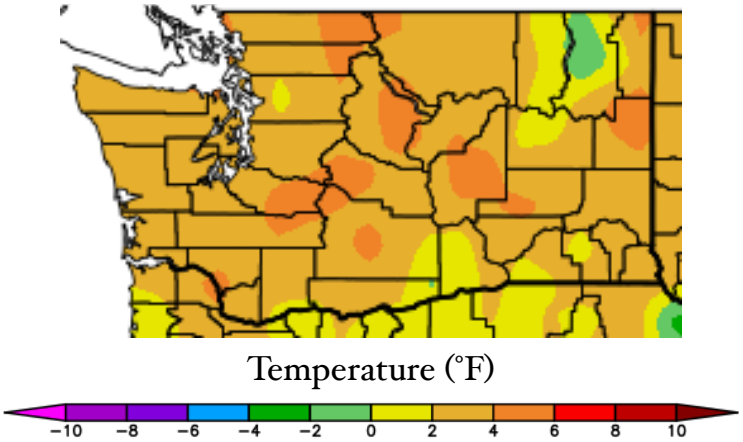
Figure 6: Observed temperatures (top) and dewpoint temperatures (bottom) at 4 pm on 28 June 2015 (from NOHRSC).

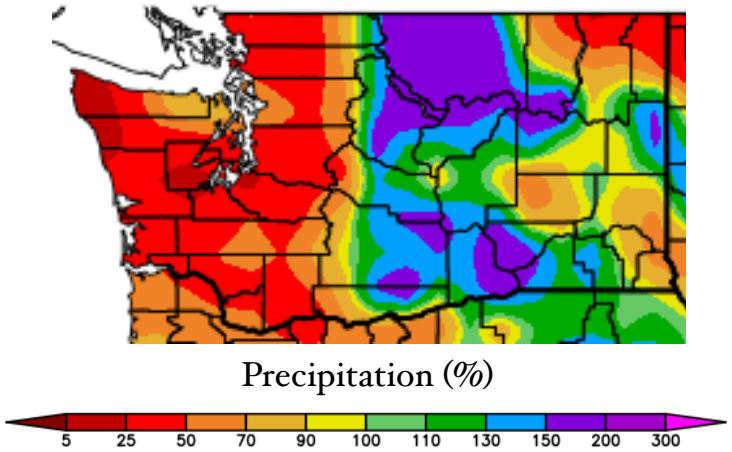
dewpoint was 65°F. The higher value of 89°F is much more hazardous; guidelines indicate that humans working or exercising in this kind of environment become heat stressed in just 20 minutes. Long-term trends show that summer time values of absolute humidity as well as temperature are creeping up in WA state, and so unfortunately, this type of regional weather hazard is liable to continue to increase in severity. The National Weather Service debuted a new HeatRisk forecast product last summer to supplement their heat advisories, watches, and warnings, which was featured in our June 2018 newsletter. With the warm season upon us, we thought it could not hurt to provide a reminder of the existence of this resource.

Climate Summary

Mean May temperatures were above normal across most of WA state. According to the map from the High Plains Regional Climate Center (right), temperatures were mostly between 2 and 4°F above normal. SeaTac Airport, Spokane Airport, and Pasco were even warmer, with anomalies of 4.5, 4.3, and 4.9°F above normal, respectively (Table 2).

Total May precipitation was variable throughout the state, with all of western WA and northeastern WA receiving below normal precipitation and portions of eastern WA receiving above normal precipitation. Areas of coastal WA were particularly dry during May, with Quillayute and Hoquiam only receiving 16 and 32% of normal precipitation, respectively (Table 2). Other western WA locations received between 25 and 50% of normal precipitation, such as the 48% of normal measured in Bellingham. Parts of Pend Oreille, Stevens, and Ferry counties in northeastern WA only received between 25 and 50% percent of normal precipitation as well. On the other hand, north central WA and the eastern slopes of the Cascades received between 150 and 200% of normal May precipitation. Omak and Hanford had the highest percentage compared to normal with 180 and 185%, respectively. Further east, in Spokane and Pullman, precipitation was below normal (83 and 77% of normal, respectively), but not as low as in western WA.





May temperature (°F) departure from normal (top) and precipitation percent of normal (bottom). (High Plains Regional Climate Center; relative to the 1981-2010 normal).

	Mean Temperature (°F)			Precipitation (inches)		
	Average	Normal	Departure from Normal	Total	Normal	% of Normal
Western Washington						
Olympia	57.5	54.2	3.3	0.90	2.33	39
Seattle WFO	59.5	56.0	3.5	1.45	2.16	67
SeaTac AP	60.5	56.0	4.5	0.62	1.94	32
Quillayute	54.0	51.3	2.7	0.80	5.11	16
Hoquiam	55.4	53.0	2.4	1.20	3.29	36
Bellingham AP	57.9	53.8	4.1	1.20	2.48	48
Vancouver AP	60.5	58.1	2.4	1.55	2.47	63
Eastern Washington						
Spokane AP	59.4	55.1	4.3	1.35	1.62	83
Wenatchee	63.4	59.8	3.6	0.62	0.68	91
Omak	61.8	58.1	3.7	2.26	1.22	185
Pullman AP	56.7	53.2	3.5	1.20	1.56	77
Ephrata	63.4	59.3	4.1	0.83	0.65	128
Pasco AP	65.6	60.7	4.9	0.63	0.73	86
Hanford	65.6	62.1	3.5	0.92	0.51	180

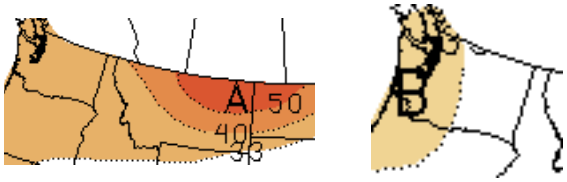
Table 2: May 2019 climate summaries for locations around Washington with a climate normal baseline of 1981-2010. Note that the Vancouver Pearson Airport and Seattle WFO 1981-2010 normals involved using surrounding stations in estimating the normal, as records for these station began in 1998 and 1986, respectively.

Climate Outlook

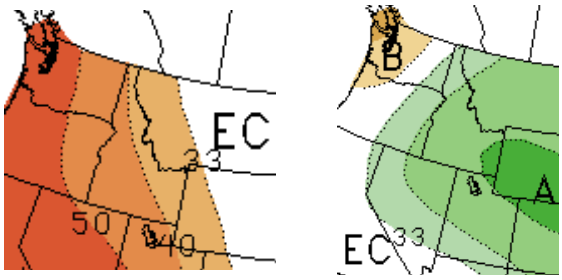
Weak El Niño conditions are still present in the tropical equatorial Pacific, with above normal sea surface temperatures persisting and even strengthening a bit in the eastern equatorial Pacific. The "El Niño Advisory" issued by the Climate Prediction Center on February 14 is also still in effect. There is about a 70% chance that the El Niño will last through the summer, but fall forecasts are less certain at this time. The chance of the El Niño persisting through fall is elevated to 58%, while the chance of neutral conditions is at about 35%. A La Niña is looking much less likely, with only about an 7% chance for fall 2019.

The CPC June temperature outlook calls for slightly increased chances (between 33 and 40% on the three-tiered system) of above normal temperatures for all of WA state. June precipitation is likely to be below normal west of the Cascades, while there are equal chances of below, equal to, or above normal precipitation in eastern WA.

The CPC summer (June-July-August) seasonal temperature outlook calls for warmer than normal temperatures statewide, with the highest chances (exceeding 50% on the three-tiered system) for western WA. There are higher chances of below normal summer precipitation for the western half of WA, including the Cascades. The remainder of the state is split between equal chances of below, equal to, or above normal precipitation and higher chances for above normal precipitation further east.



June outlook for temperature (left) and precipitation (right)



June-July-August outlook for temperature (left) and precipitation (right)

(Climate Prediction Center)