Office of the Washington State Climatologist

June 2020 Report and Outlook

June 5, 2020

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

May Event Summary

Mean May temperatures were slightly above normal for most areas of the state with warmer anomalies in the Columbia River Basin and along the Puget Sound. May's precipitation distribution is highlighted by anomalously high precipitation in the eastern third of the state. The rest of the state saw greater spatial variance with pockets of higher than normal precipitation in the Puget Sound and south-central Cascades, while areas nearby on the Coast and in the Columbia River Basin saw lower than normal precipitation. Looking at Figure 1, a wet May compensated for the lack of rain during April in the eastern third of Washington, but the central and southern Cascades, and the Washington Coast featured a bottom 10% percentile total for spring (March-April-May) precipitation.

May began with a period unsettled weather as on-shore flow brought regular showers to western Washington with few showers reaching eastern Washington. A large-scale high-pressure zone moved in on the 7th reversing the pattern to off-shore flow, warming up and drying out the state. The high pressure caused warm air to surge in from the south, spiking temperatures from the 8th through the 10th. Air descending off the

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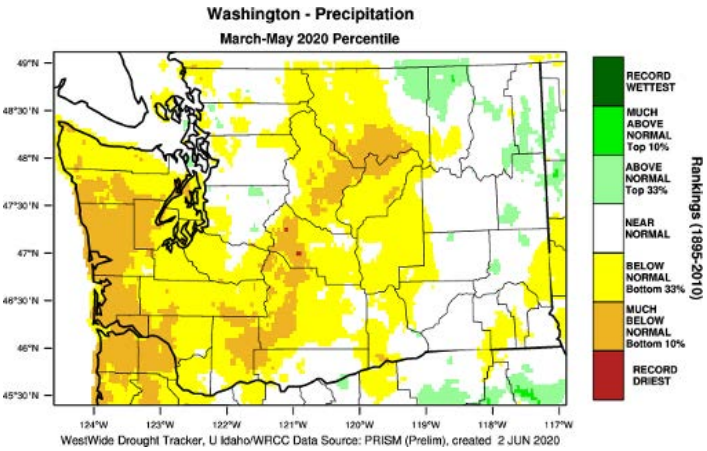

Figure 1: Spring (March-April-May) 2020 precipitation total percentiles for WA state based on rankings from 1895-2010 (Westwide Drought Tracker).

Cascades amplified warming in western Washington causing temperatures to be higher west of the Cascade Crest. Daily temperature

records were broken at SeaTac, Seattle WFO, Olympia AP, Quillayute, Bellingham AP on both May 9th and 10th. Bellingham and Hoquiam both broke daily high temperature records on the 8th, but Hoquiam failed to reach their daily records on the subsequent two days by a single degree each day.

The high pressure broke down on the 11th with the arrival of cooler and unsettled weather, marking the end of western Washington's first heat wave of 2020. The unsettled pattern continued through the 20th, when a low-pressure system brought significant precipitation to Eastern Washington captured by CoCoRaHS observers in Figure 2. This precipitation broke daily records for Walla Walla at 1.66", Pullman at 0.98", Spokane at 1.19", and at Seattle WFO a day later at 1.15". The weather pattern transitioned to clear skies and another round of warming between the 27th and 29th. A cut-off low pressure system arrived early on the 30th causing significant upper air temperature swings, which destabilized the atmosphere and initiated statewide thunderstorms that broke daily precipitation records at Bellingham AP and SeaTac at 0.78" and 1.06", respectively.
The abundance of unsettled weather resulted in one of the wetter May's on record. Table 2

Figure 2: CoCoRaHS rainfall reports for May 20th (CoCoRaHS)

Station	May Total Precipitation (in)	Rank	Record (Amount; Year)	Record Began
SeaTac AP	3.12"	9	4.76"; 1948	1945
Snohomish County AP	3.37"	4	6.07"; 1948	1948
Spokane	3.24"	7	5.71"; 1948	1881
Walla Walla	3.60"	5	6.63"; 1991	1949
Pullman	3.91"	1	-	1998

Table 1: A sample of stations in WA with total May precipitation rankings in the top ten wettest on record.

shows that stations in both eastern and western Washington saw top 10 totals in precipitation. While this might have been Pullman's wettest May only due to their relatively short 22 years of data, May of 2020 had 73% more precipitation that the previous record in 2009.

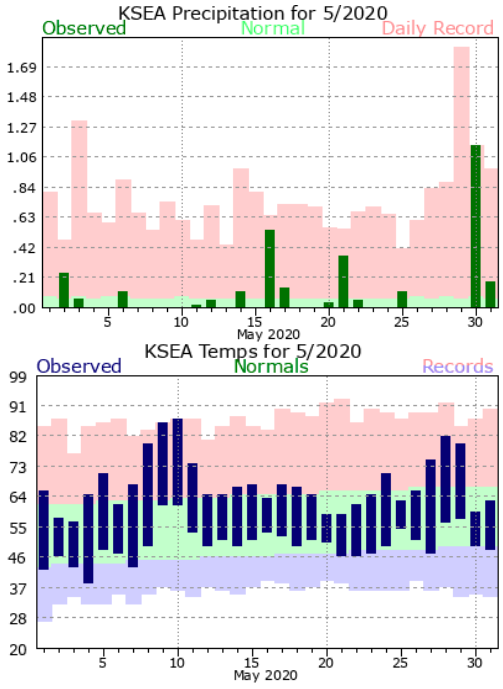

Figure 3: Daily April 2020 (a) maximum and minimum temperatures and (b) precipitation compared to normal (green envelope) and records (red and blue bars) for SeaTac Airport (NWS).

Snowpack and Drought

Warm May temperatures contributed to acceleration in snowpack melt bringing basin wide averaged Snow Water Equivalent (SWE) down from near normal values to slightly below normal values. In last month's OWSC newsletter, we reported that the basin averaged SWE was healthy at near normal values of 72-114%, but low elevation sites had undergone rapid melting. In the previous month, warmer than normal temperatures further melted out many low elevation sites, and brought rapid melting to high elevation sites such as Paradise (Fig 4). Many sites to west of the Cascade Crest are maintaining snowpack relative to comparable elevation sites east of the Crest. This east-west disparity can be seen in Table 2 with, for example, Alpine Meadows sitting at 107% of normal SWE compared to nearby Lyman Lakes at 46%. Various sites such as Bunchgrass Meadow, Sheep Canyon, and Stevens Pass still have a small amount of snowpack remaining. These sites usually have melted out by June, making for an exorbitantly high percent of normal SWE, and do not accurately reflect the state of the snowpack.

Above normal precipitation in western Washington and the eastern third of the state helped reduce some areas of "Abnormally Dry" (D0) conditions that were introduced after a significantly dry April. D0 conditions are no longer present in the Olympic Peninsula and southern Puget Sound, but still remain in southwest Washington where May's precipitation totals were slightly below normal. While most of eastern Washington featured significant May precipitation, most precipitation events skipped over the Lower Columbia River basin leading to "Severe Drought" D2 conditions to expand into

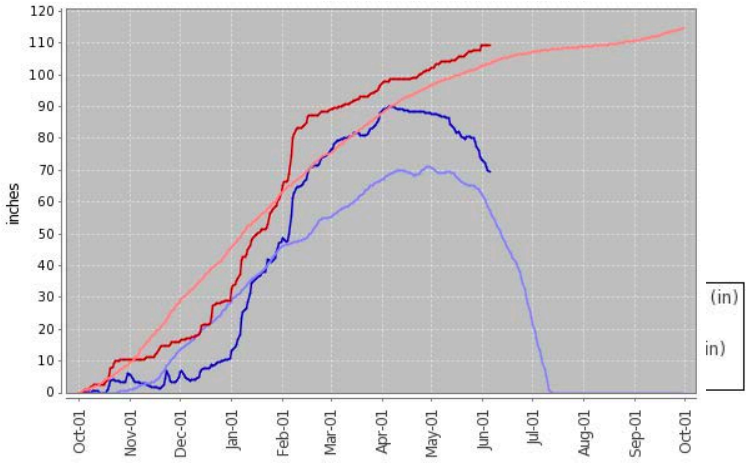

Figure 4: 2020 water year accumulated SWE (blue) compared to normal (light blue) for Paradise at 5130' showing accelerated melting (NRCS).

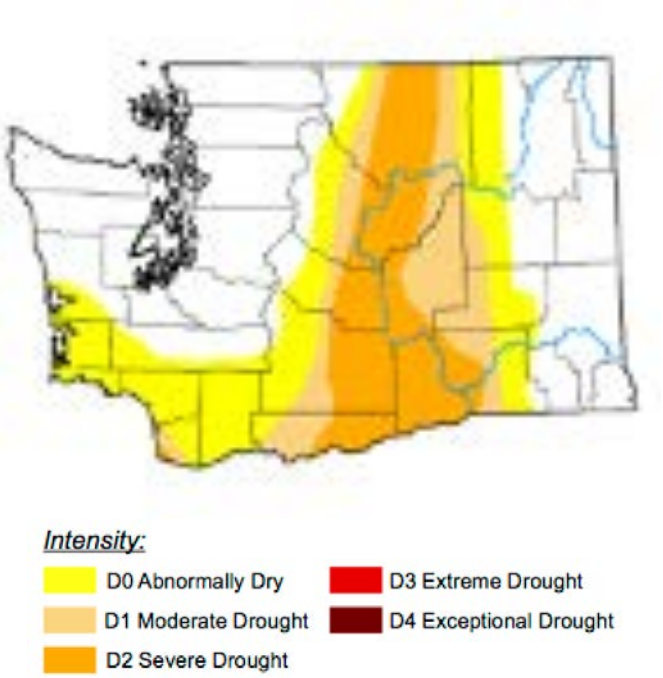

Figure 5: The June 2020 edition of the U.S. Drought Monitor.

Benton County. Figure 6 from the USGS reveals lower than normal May averaged streamflows in the Lower Yakima Basin where D2 drought is expanding. Relatively high streamflows in Okanogan County, where D2 drought persists, is due to rapid snowpack melt.

Location	Station	SWE	SWE %	El.	Crest Location
North Cascades	Rainy Pass	12.2″	76%	4890	East
	MF Nooksack	48″	101%	4970	West
Central Cascades	Lyman Lakes	21.2″	46%	5980′	East
	Alpine Meadows	28.8″	107%	3500′	West
South Cascades	Surprise Lakes	4.7″	37%	4290′	East
	Swift Creek	28.3″	79%	4440′	West

Table 2: A comparison of nearby SNOTEL stations based on their location east or west of the Cascade Crest.

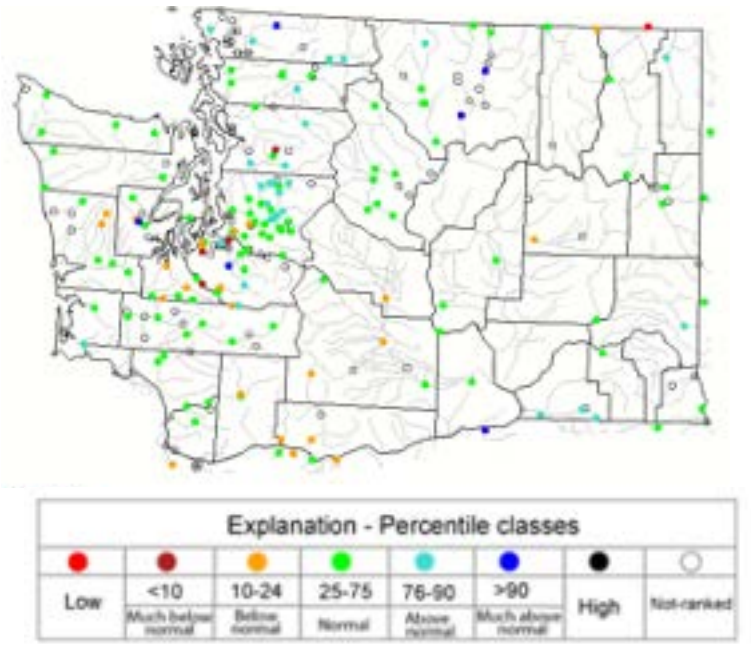

Figure 6: 28-day average streamflows for WA ending 30 April 2020 (from USGS).

The CoCoRaHS Corner

Tired of watching the grass grow?

The Community Collaborative Rain, Hail & Snow (CoCoRaHS) is a network of volunteer observers who help map and track precipitation by submitting daily observations at their homes and places of work. Last month, we received 10801 precipitation reports from 400 observers, of which, 204 observers were able to submit reports for every single day in May. Great work! As the summer season approaches, chances of receiving precipitation will continue to plummet. While the occasional heavy downpour from a thunderstorm or a convective system is certainly exciting, equally important are reports of zeros to monitor drought. In addition, Condition Monitoring Reports are helpful tools to get an impression of the water supply in your area that doesn't always come across in the numbers. Please share the word about CoCoRaHS to your family and friends whether they are in the United States and even Canada. And remember, be a "Zero Hero." New volunteers can find additional info at www.cocorahs.com

Springtime Stream Temperatures in Washington

A Message from the Washington State Climatologist

We have used this space to discuss ocean temperatures a number of times in recent years. Here, we will again consider water temperatures, but in this case for Washington State rivers, with a focus on the spring season. Salmon and trout suffer if the water becomes too warm. A vivid example of these impacts was represented by the snow-drought year of 2015. A record run of adult sockeye salmon entered the Columbia River that year, but relatively few reached their spawning grounds due to exceedingly warm water temperatures. The Columbia River at The Dalles, for example, had a mean June temperature of 19.3 C, which was 3.2 C warmer than normal. With that kind of an event in the recent past, we will take a look at the stream temperatures this spring to date, and the strength of the correspondence between seasonal mean stream temperatures and air temperatures.

A number of other groups have investigated this topic. For example, Isaak et al. (2012) documented the trends in seasonal mean stream and air temperatures in the Pacific Northwest, and showed that they generally tracked one another. Though, this study included a sole location in Washington: the Snake River near Antone in the southeast corner of the state. Our modest effort to complement this and other previous studies was hampered by the lack of data easily available online. There is much more streamflow/discharge data than stream temperature data, particularly on unregulated streams. That being said, we forged ahead and grabbed daily data for two streams: the Nooksack River at Ferndale and the Okanogan River at Malott, to illustrate water temperatures during April and May of 2020. We also collected seasonal mean temperatures for April through June for those two rivers, and three others (the Cedar River at Renton, the Tolt at Carnation, and the Columbia at The Dalles) for the years of 2005-2019. The spring temperatures in those 5 rivers are compared with air temperatures for WA state as a whole. The water temperature data was downloaded from the following website: https://waterwatch.usgs.gov/wqwatch/map?state=wa&pcode=00010

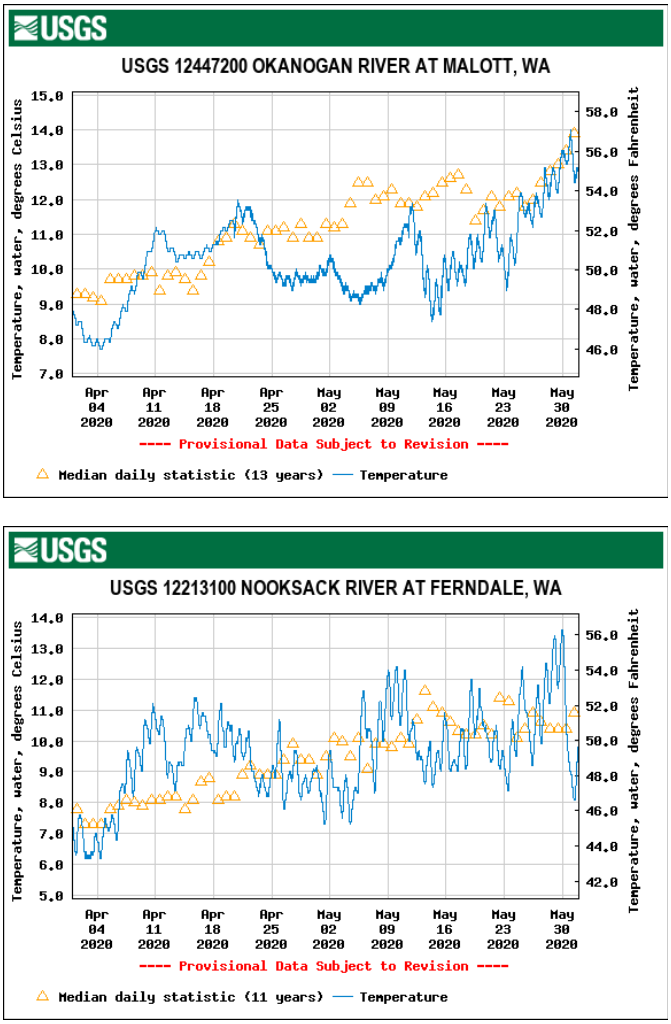

Figure 7: Daily values of water temperatures for (a) the Nooksack River at Ferndale (top) and (b) the Okanogan River at Malott (bottom) during April and May 2020. The gold triangles refer to median values for the date.

The time series of daily water temperatures for the Nooksack and Okanogan Rivers during April and May of 2020 are shown in Figs. 7a and 7b, respectively. The Nooksack ran a bit on the warm side, with considerable variability on daily to weekly time scales and an evident diurnal cycle. The Okanogan had comparable swings in temperature on weekly time scales. Both rivers had temporary maxima during the middle of April, and from 8-12 May, during periods of seasonally warm weather. The big decline in temperature for the Nooksack at the very end of May can be attributed to the cool and wet weekend that closed out the month. Even though the two rivers are in different parts of the state, and the Okanogan is subject to greater control/regulation, we were struck by the similarity in their temperatures during the two-month period.

The similarity between stream temperatures also pertains to seasonal mean values. Figure 8 shows April through June average water temperatures for the years of 2005 through 2019 on five rivers in the state. These temperatures mostly track each other, as well as the average air temperature for the state. This is especially the case for the statewide average air temperature and Cedar River water temperature; their correspondence is striking. As one might have been expected, the water (and air) temperatures were greatest in 2015. What might not be remembered so vividly is how cold it was in the spring of 2011. We hasten to add that this is not a novel result in that Isaak et al. (2012) among others, have documented the large positive correlations between seasonal mean water and air temperatures.

We close with a thought about what this relationship portends for water temperatures in WA during future decades. It turns out that the long-term temperature trends in Washington include lesser increases in spring (and fall) than during winter and summer, as reported by Abatzoglou et al. (2014). This can be accounted for, at least in part, by seasonal differences in long-term changes in the large-scale atmospheric circulation, but anything close to a satisfactory treatment of that issue is well beyond the scope of the present piece. Suffice to say that as our

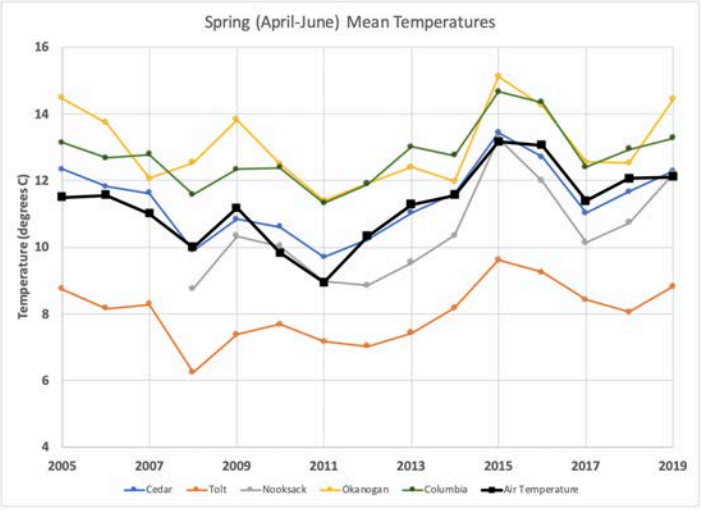

Figure 8: Mean spring (April-June) water temperatures for 5 rivers in Washington state during the years of 2005 and 2019. The seasonal mean air temperatures for the state are indicated with the solid black line. See text and legend for details.

climate continues to warm, our streams are along for the ride, with serious consequences for some native species. For more on the probable future of our rivers, readers are encouraged to check out the report published by the Climate Impacts Group of the UW, available at the following website:
https://cig.uw.edu/news-and-events/datasets/washington-state-water-temperature-projections/

References

Abatzoglou, J. T., D. E. Rupp, and P. W. Mote (2014): Seasonal climate variability and change in the Pacific Northwest of the United States. *J. Climate*, **27**, 2125–2142, doi:https://doi.org/10.1175/JCLI-D-13-00218.1.

Isaak, D.J., S. Wollrab, D. Horan, and G. Chandler (2012): Climate change effects on stream and river temperatures across the northwest U.S. from 1980-2009 and implications for salmonid fishes. *Climatic Change*, **113**, 499-524, doi:10.1007/s10584-011-0326-z

Climate Summary

Mean May temperatures were largely above normal statewide aside for a cold anomaly in Stevens County. Two seperate warm bull's eyes existed in Grant County and the border of King and Pierce County. Hanford and SeaTac AP both picked up on these warm pockets with temperatures being 4.6 °F and 3.3 °F above normal, respectively. While most areas west of the Cascades saw temperatures 1 to 4 °F above normal, temperatures east of the Cascades were only slightly on the warm side at 0 to 2 °F above normal. The cold anomaly in Stevens County should be viewed with skepticism as it is based on a single station, and has been a persistent feature that may not be representative.

Total May precipitation was above normal for most areas statewide with well-above normal precipitation in the eastern third of the state. Stations in eastern Washington such as Epharta, Pullman, and Spokane recorded 266, 251, and 250%, respectively, marking a significantly wet May. The Seattle area also saw well-above normal precipitation, but also substantial spatial variance as the Seattle WFO observed 4.21", which was 1.09" or 35% more precipitation than the nearby SeaTac AP. The Washington coast saw precipitation totals fall slightly below normal with 2.90" in Hoquiam and in 4.53" in Quilayute. Interestingly enough, both of these values account for 88% of normal May precipitation. The dry anomaly in eastern Chelan county is based off three stations reporting below normal precipitation; though 118% of normal precipitation at the Wenatchee suggests local variability was at play.

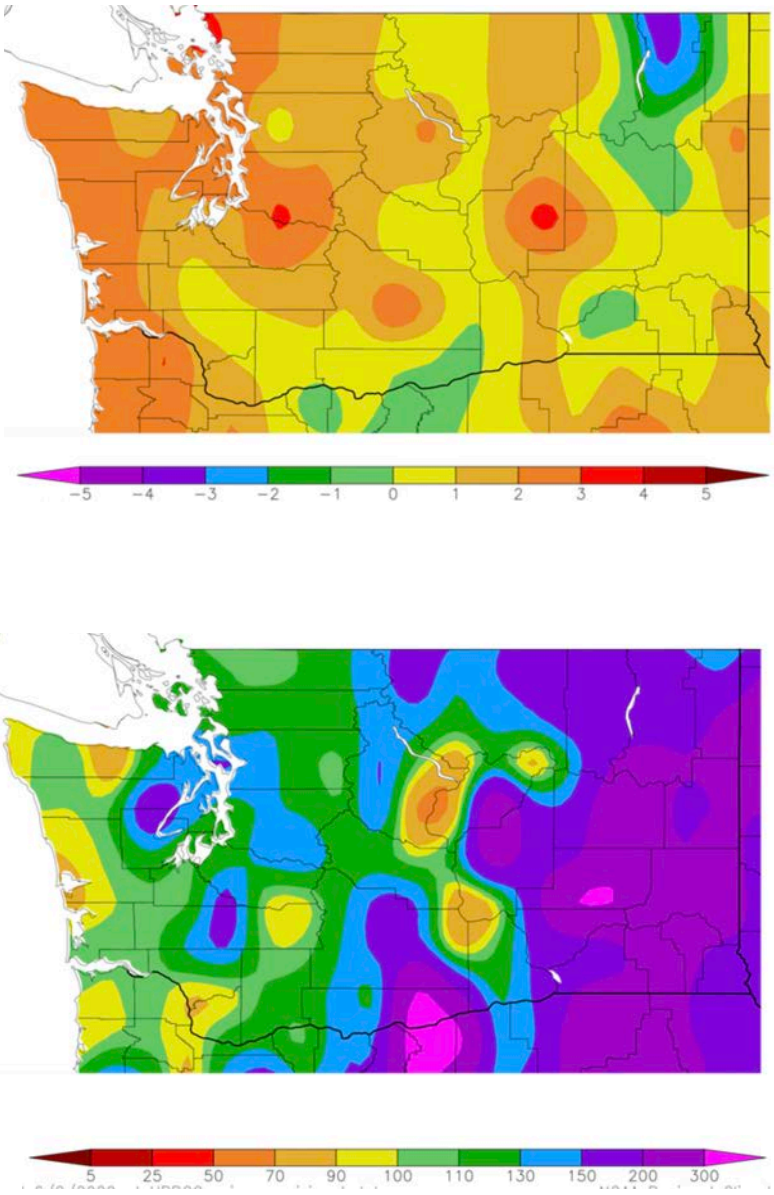

Figure 9: May temperature (°F) departure from normal (top) and precipitation percent of normal (bottom). (High Plains Regional Climate Center; relative to the 1981-2010 normal).

	Mean Temperature (°F)			Precipitation (inches)		
	Avg	Norm	Departure from Normal	Total	Norm	% of Norm
Western Washington						
Olympia	56.2	54.2	2.0	2.87	2.33	123
Seattle WFO	58.7	56.0	2.7	4.21	2.16	225
SeaTac AP	59.3	56.0	3.3	3.12	1.94	161
Quillayute	53.4	51.3	2.1	4.52	5.11	88
Hoquiam	55.6	53.0	2.6	2.90	3.29	88
Bellingham AP	56.9	53.8	3.1	3.08	2.48	124
Vancouver AP	59.6	58.1	1.5	2.68	2.47	109
Eastern Washington						
Spokane AP	55.7	55.1	0.6	3.24	1.62	200
Wenatchee	60.3	59.8	0.5	0.80	0.68	118
Omak	59.7	58.1	1.6	1.75	1.22	143
Pullman AP	54.4	53.2	1.2	3.91	1.56	251
Ephrata	60.9	59.3	1.6	1.73	0.65	266
Pasco AP	63.0	60.7	2.3	1.08	0.73	148
Hanford	66.7	62.1	4.6	0.50	0.51	98

Table 3: May 2020 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

According to the Climate Prediction Center (CPC), El Niño-Southern Oscillation (ENSO) is currently in a neutral phase in the equatorial Pacific Ocean. Both atmospheric and oceanic conditions are consistent with a neutral state pf ENSO. Average sea surface temperatures (SSTs) across the basin are near to normal with slightly above normal SSTs in the western Pacific Ocean, and slightly below normal values in the central and eastern Pacific Ocean. Cooling has continued basin-wide since early-April with a maximum decrease of 2 °C in pockets of the Eastern Pacific. ENSO forecast models place a 71% chance of neutral ENSO conditions continuing through the summer months of June-July-August. While models indicate that ENSO may be headed to a cool phase, ENSO neutral conditions are still favored through September-October-November at a 44% chance.

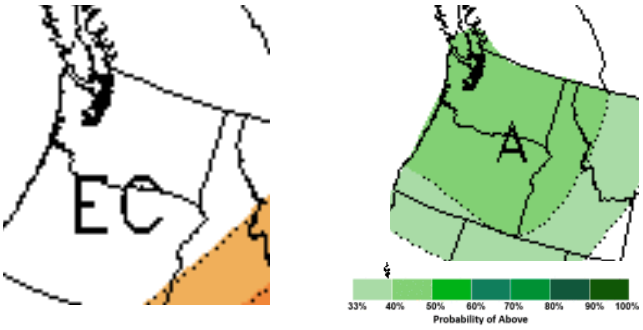

Figure 10: June outlook for temperature (left) and precipitation (right) ([Climate Prediction Center](#))

The CPC June outlook gives equal chances above, below, and near to normal temperatures statewide indicating little about the month ahead. The precipitation outlook indicates increased chances of between 40 to 50% of above normal precipitation for the entire state.

The CPC June-July-August (JJA) seasonal temperature outlook gives increased chances of above normal temperatures statewide. South-central Washington has higher chances of above normal temperatures than the rest of the state. For example, Yakima has a 59% chance of above normal temperatures while Everett has at a 55% chance. The summer precipitation outlook gives increased chances of below normal precipitation statewide. Coastal areas see only a slight increased chance of below normal precipitation at 33 to 40%.

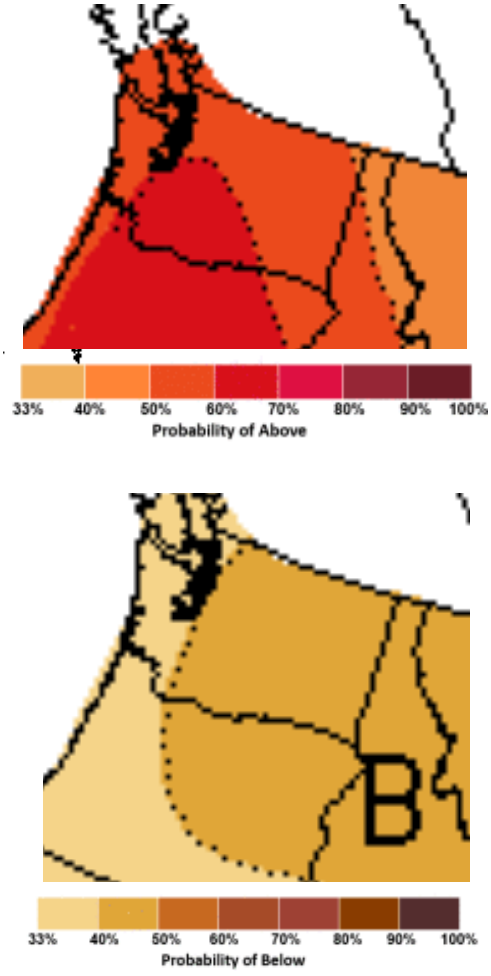

Figure 11: June-July-August outlook for temperature (top) and precipitation (bottom)