Office of the Washington State Climatologist

February 2020 Report and Outlook

February 6, 2020 http://www.climate.washington.edu/

January Event Summary

Mean January temperatures were above normal for most of the state, with greater temperature anomalies in eastern WA. The exceptions were the higher elevations of the Olympic and Cascade Mountains, which had below normal to near-normal temperatures. Precipitation was much above normal for nearly the entire state, with only one pocket of below normal precipitation in the Lower Columbia Basin. The total January precipitation ranked among the top 10 wettest in the historical record for stations in western WA, northeastern WA, and the Pullman area. Table 1 shows selected stations from these areas; notably January 2020 precipitation totals at both Quillayute and Priest River Experimental Station were the greatest on record. Averaged statewide, January 2020 ranks as the 4th wettest January on record with 4.19" above the 1981-2010 normal.

The number of days with precipitation was also notable for the month. Spokane International Airport recorded 24 days with measurable precipitation (>0.01"), tying 1969 with the second-most on record for January. As shown in Figure 1, SeaTac Airport had 28 days of measurable precipitation for the month. This ties 2006 and 1953 for the highest number on record. January 1 was the only day at SeaTac AP with no precipitation (both the 16th and the 20th had a "trace"). The first day of the year was also relatively warm. Ephrata (54°F), Wenatchee Pangborn Airport (51°F), and Omak (49°F) recorded daily high temperature records on that date. Elsewhere in the state, SR 240 was closed for hours in Benton county due to tumbleweeds that blocked the road from gusty conditions. Mild temperatures continued through the 3rd, with record high maximum temperatures set at Bellingham (61°F), Walla Walla (61°F), SeaTac Airport (59°F), and Hoquiam (57°F) before gusty winds were ushered in during the afternoon and evening in association with a cold frontal passage.

Heavy rain fell in western WA on the 6th with maximum rainfall records set at Olympia (3.01")

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Station	Total January Precipitation (in)	Rank	Record (Amount/Year)	Records Began
Priest River Exp Station	8.71	1	-	1900
Quillayute	30.78	1	-	1967
Hoquiam	19.91	2	23.46"; 2006	1954
Elma	21.40	2	23.61"; 1953	1941
Northport	4.36	2	6.29"; 2004	1900
Whidbey Island NAS	3.95	5	6.09"; 1971	1950
Pullman 2 NW	4.43	6	8.60"; 1953	1941
SeaTac AP	9.23	6	12.92"; 1953	1945
Bellingham AP	7.02	9	10.58"; 1971	1949

Table 1: Total January precipitation records for selected WA stations.

and Hoquiam (2.57"). As a result, there were minor to moderate floods on numerous western WA rivers. Cooler air moved into the state later that week, with snow falling in eastern WA north of I-90 on the 10th. Spokane Airport (7") happened to set a daily snowfall record on that day. The cooler temperatures and continued precipitation really helped build our mountain snowpack from the 9th through the 11th.

The atmospheric pattern shifted on the 12th, however, setting up ideal conditions for western WA lowland snow for the next several days. While the Canadian arctic air didn't extend as far south as originally forecast, western WA (and the whole state) did receive snow beginning on the 12th. As of the morning of the 13th, the heaviest western WA snow was in the Port Angeles area, and in an area extending from northern Kitsap county, south of Everett, and Redmond, due to the set up of the Puget Sound Convergence Zone. Snow also fell statewide on the 13th, while the snow on the 14th in western WA was mainly from Seattle northward. Figure 2 shows the 24-hr snowfall totals from CoCoRaHS observers ending on the morning of the 15th. As shown, the heaviest western WA snow fell in Bellingham, Anacortes and the San Juan Islands, and the Port Angeles area (pictures). More snow fell in localized locations around the state through the

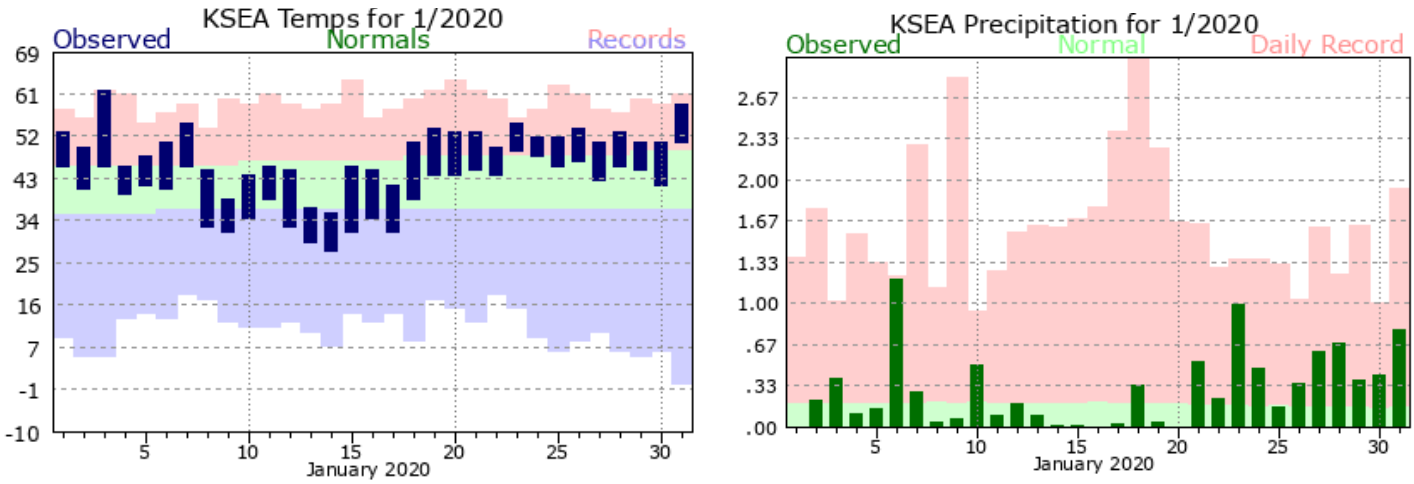


Figure 1: Daily January 2020 (left) maximum and minimum temperatures and (right) precipitation at SeaTac Airport compared to normal (green envelope) and records (red and blue bars). NWS

17th, but then temperatures warmed to above normal for most of the rest of the month.

For the remainder of the month, precipitation was frequent and heavy enough to cause more river flooding. Quillayute set maximum rainfall records on both the 30th (2.31") and the 31st (4.01"), with Bellingham also setting a record on the 31st (1.34"), which was a very mild and wet day for most of the state.

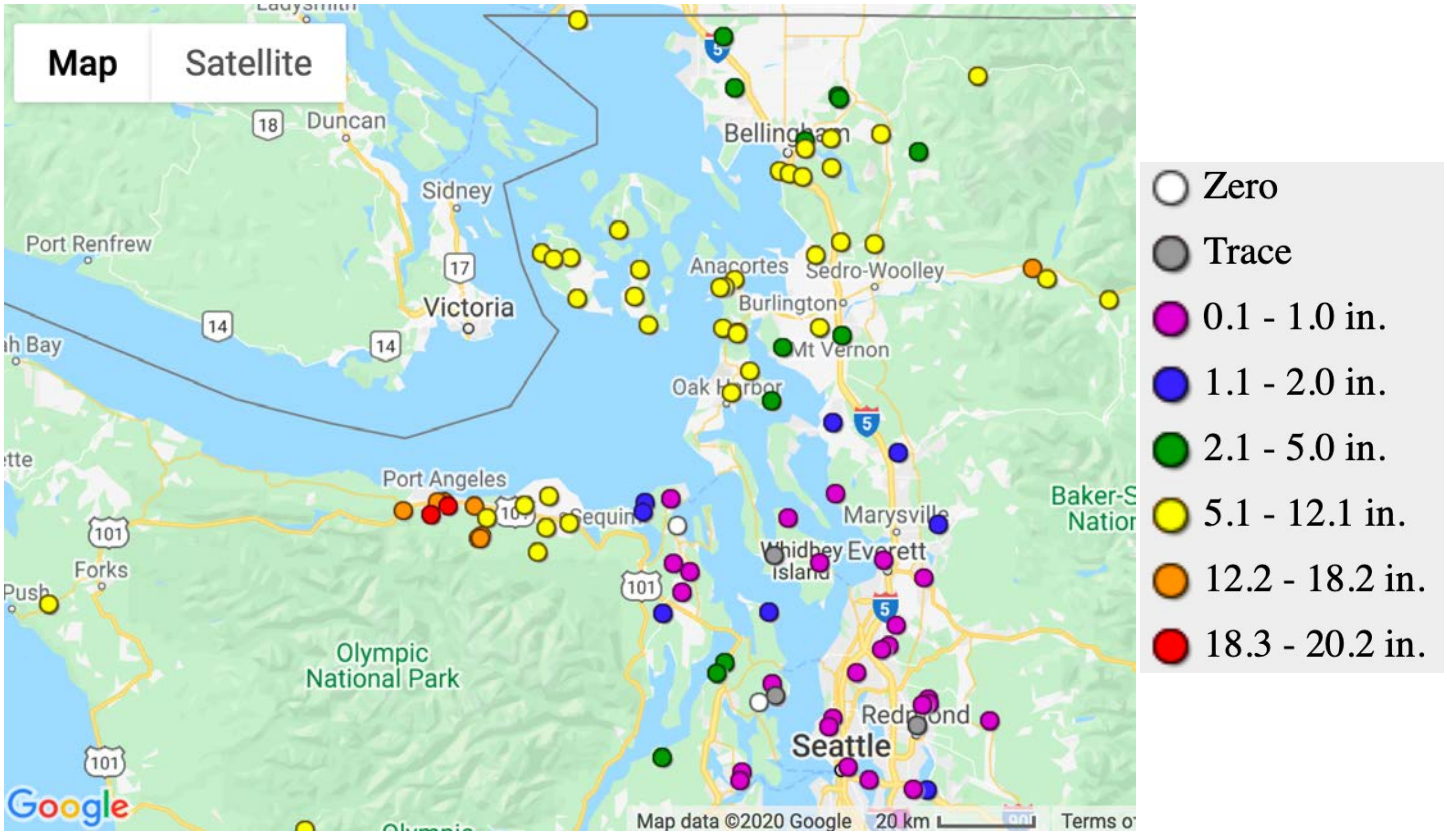


Figure 2: 24-hr snowfall totals ending between 7 and 9 am on January 15, 2020 (CoCoRaHS).

Snowpack and Drought Monitor Update

There were huge gains in mountain snowpack during January, as illustrated in the February 1 basin average snow water equivalent (SWE) percent of normal from the Natural Resources Conservation Service (NRCS; Figure 3). The Olympic and Spokane basins are now above normal (118 and 108% of normal, respectively), which is a sizable improvement from the January 1 averages of 47 and 79% of normal, respectively. The period of Jan 1 to 15 saw record increases in snow depth for that time period for many Snotel sites throughout the Olympics and Cascades. As of February 1, the North Puget Sound, Central Puget Sound, South Puget Sound, Lower Columbia, and Lower Yakima all have near-normal SWE. The Upper Columbia, Central Columbia, and Lower Snake-Asotin are still below normal (between 76 and 88% of normal for the basin), but these are still substantial improvements from a month ago.

The latest U.S. Drought Monitor (Figure 4) shows drought-free conditions in western WA, which represents improvement from last month. Above normal January precipitation, improving mountain snow, and higher than usual streamflows have all contributed to these changes. On the other hand, "moderate drought" (D1) has increased in the parts of eastern WA that have remained dry while some of the "abnormally dry" (D0) conditions have improved. Stay tuned to the weekly Drought Monitor map releases as conditions evolve this winter.

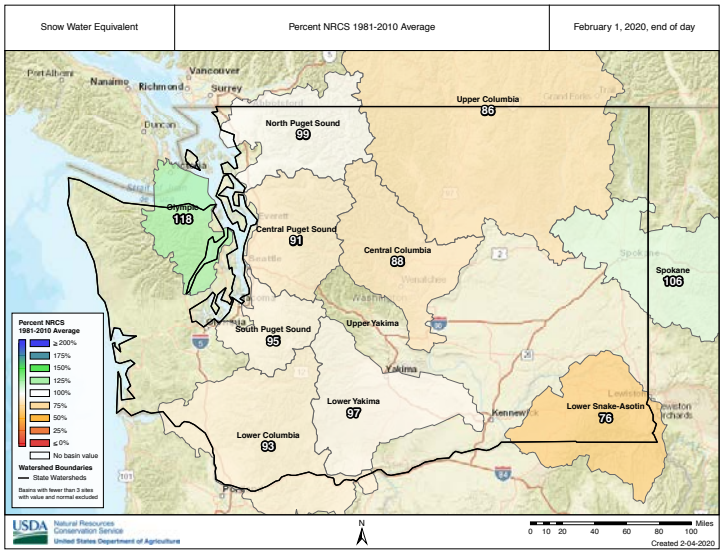


Figure 3: Snowpack (in terms of snow water equivalent) percent of normal for Washington as of February 1, 2020 (from NRCS).

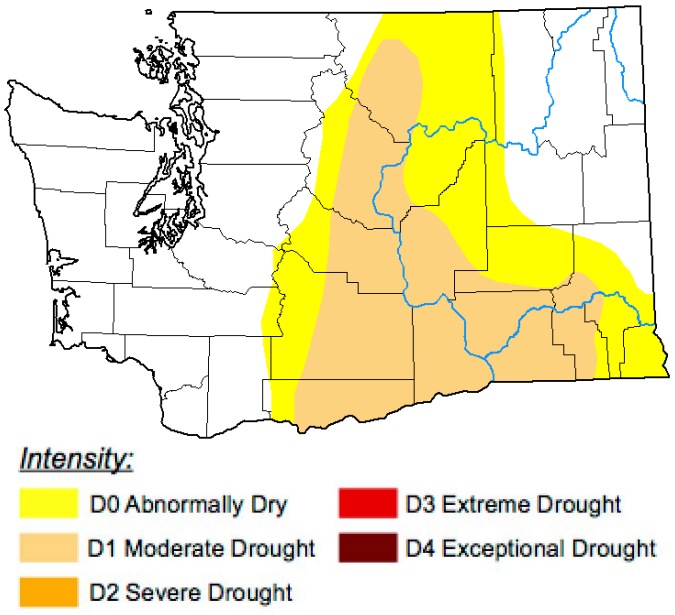


Figure 4: The 6 February 2020 edition of the U.S. Drought Monitor.

Timing of Major Floods on 6 Rivers in WA State

A message from the State Climatologist

The dry weather of autumn 2019 in an overall sense resulted in relatively low streamflows throughout most of WA state, but that story has changed drastically since late December. Since then there have been several periods of above normal streamflows with a number of rivers spilling over their banks. Now that we're seeing some floods, especially west of the Cascade Mountain crest, we were wondering: do major floods always occur when streamflow is climatologically high?

Towards that end, we considered 6 mostly unregulated rivers – 3 in western WA and 3 in eastern WA – and examined the standardized monthly mean streamflow and the timing of the top 20 peak streamflow events. The records are all relatively long and are as follows: Chehalis River at Porter (1947-2017), Hoh River at Highway 101 (1961-2017), Stillaguamish River at Arlington (1929-2017), Little Spokane River at Dartford (1929-2019), Wenatchee River at Peshastin (1929-2019), Klickitat River at Pitt (1929-2017).

Figure 5 shows the monthly mean streamflow in standardized format for all 6 rivers, illustrating some major distinctions that can be made for these rivers. The Chehalis River is the most rain dominant of the bunch, and is classified as such. Rain dominant basins have their highest streamflow in the fall, when most of the basin precipitation falls as rain. The other western WA rivers –the Stillaguamish and Hoh – have their highest flows in the fall as a response to rain as well, but they also have an increase in monthly streamflow in April/May (Stillaguamish) and June (Hoh). These are known as "mixed basins" since there is a clear contribution to streamflow from melting snow at higher elevations. The Klickitat is also a mixed basin, with peaks in both February and May. Finally, the Wenatchee River is an example of a "snow dominant" basin; May and June have relatively high streamflows due to the snowmelt contribution. The Little Spokane is a snowmelt basin as well, with an earlier peak streamflow in April. It is worth pointing out that all of the rivers, regardless of their classification, have their lowest flows in August and September, a time of

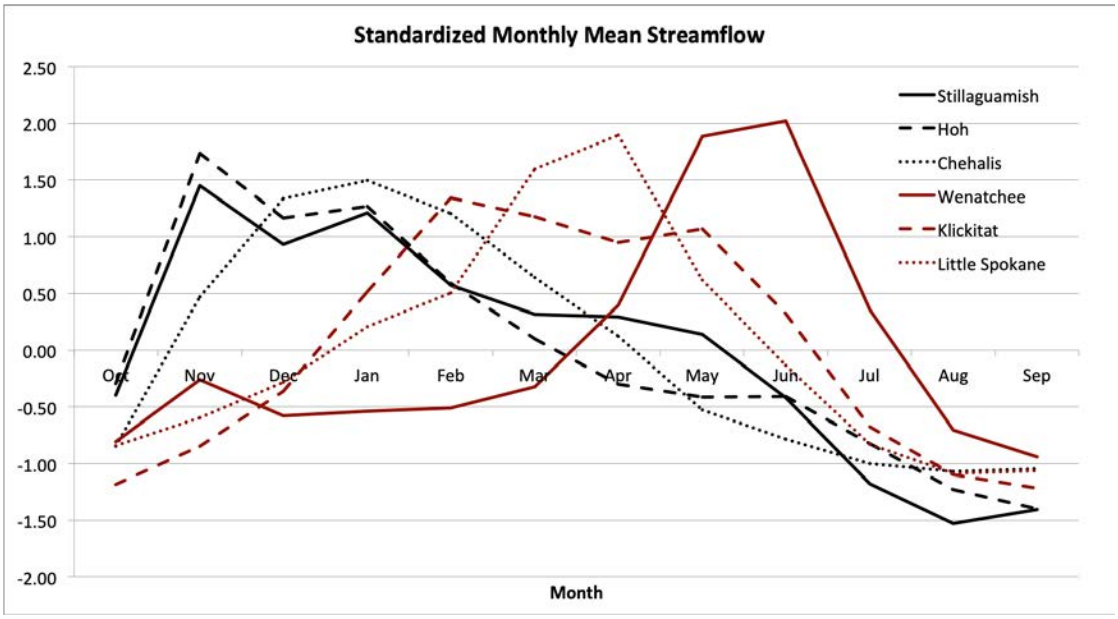


Figure 5: Monthly mean standardized streamflow at each of the 6 rivers over their period of record.

year when much of the state has its greatest need for water. Perhaps the monthly timing of the peaks and nadirs of streamflow are already well-appreciated, but do they necessarily line up with the major floods occurring on these rivers?

Figure 2 shows the timing of the top 20 peak flow events for each river, and the results are not entirely intuitive. The Little Spokane, for example, has its major floods relatively early in the calendar year (Jan-Apr) despite it being a snowmelt dominated river. The Wenatchee, on the other hand, clearly gets its biggest floods during the May and June snowmelt season. Nevertheless, that doesn't mean it never experiences floods during fall. Five of the top 20 peak flows on the Wenatchee occurred in November or December, so it's still a risk in a snow-dominant basin. Some less surprising results came in for the Chehalis; this rain dominant river has had the lion's share of its floods in December and January. One wrinkle here is that the mean streamflow in February remains relatively high during a time of year when the frequency of major flood events drops off. That being said, the flood of early February 1996 on the Chehalis was a real doozy (the second greatest in its entire record). The Hoh River, on the SW Olympics downstream of some of the highest annual precipitation totals in the state, sees early fall flooding and none of the top 20 peak streamflows occurred during the snowmelt season. Similar results are shown for the Stillaguamish, but it's interesting that its top 20 peak streamflows are more evenly distributed through the fall months than those on the Hoh or Chehalis. Finally, on the Klickitat, there aren't peak streamflows from snowmelt in the spring here despite it being a mixed basin with two peaks in mean monthly streamflow. The greater flows seem to be more rain dominated than might be expected.

To summarize, there are some surprises regarding the timing of the peak streamflows compared to the when the mean streamflow is highest, but most of the historical floods on these 6 rivers occur in the month in which the mean flows are already high (ex. Hoh, Chehalis, and Wenatchee). Still, the historical record indicates that major flooding could occur on many of our rivers anytime from October through June, despite the basin type. Those impacted by river flooding are well-advised to stay informed of the latest forecasts from the National Weather Service through the entirety of the wetter part of the year.

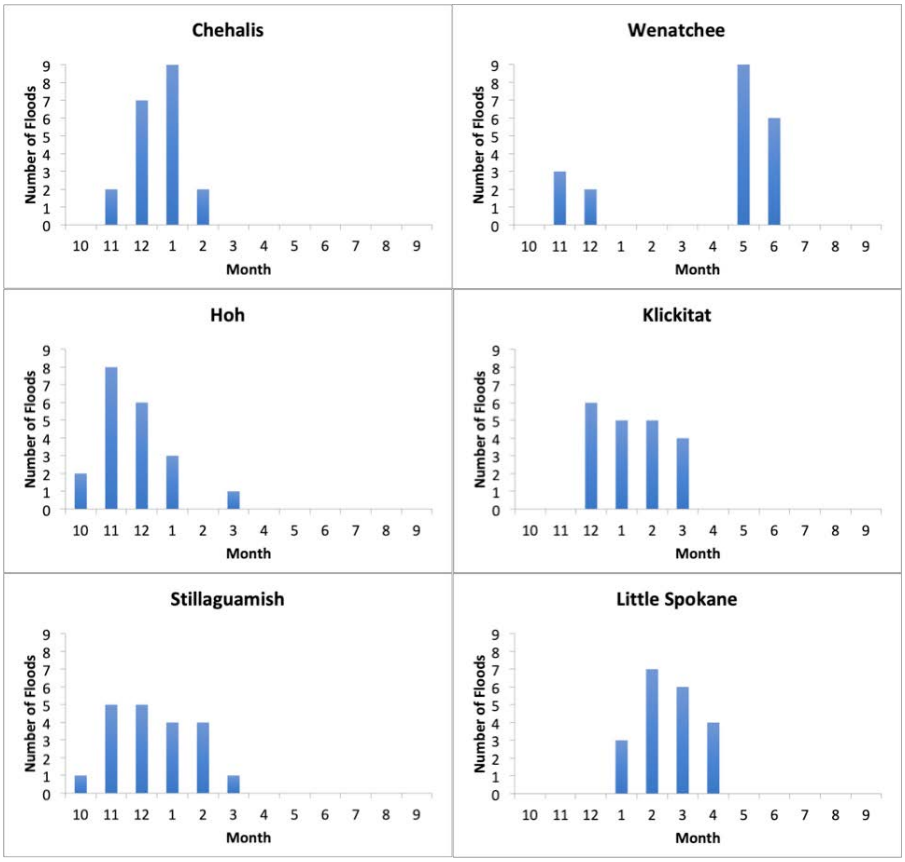
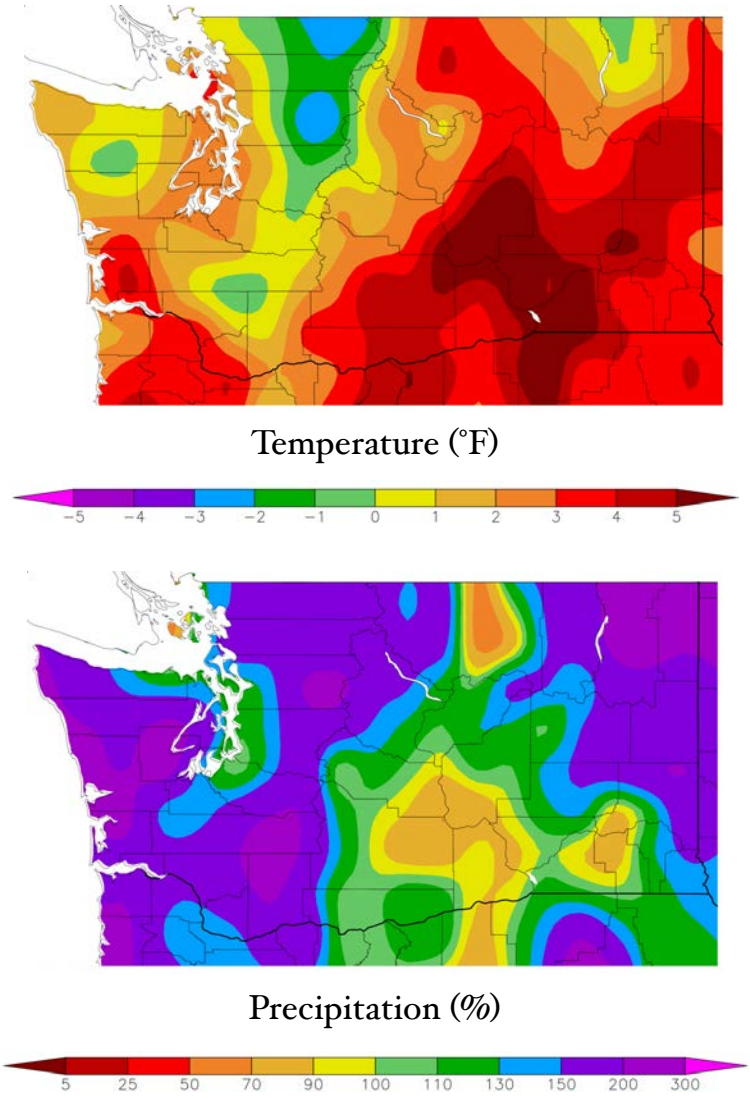


Figure 6: The monthly timing of the top 20 peak streamflow events for each river.

Climate Summary

Mean January temperatures were above normal for most of the state, according to the map from the High Plains Regional Climate Center on the right-hand side. Temperature anomalies in eastern WA were mostly between 2 and 5°F above normal. Pasco and Hanford were hot spots, with mean January temperatures that were 5.9 and 5.4°F above normal, respectively (Table 2). January temperatures in the western WA lowlands were moderate, but still warmer than normal, with anomalies of 2.1, 2,2, and 3.0°F for Bellingham, Hoquiam, and SeaTac Airport, respectively. On the other hand, mean temperatures in the Olympic Mountains and the Cascades were the exception, with near-normal to below normal anomalies as illustrated by the yellow, greens, and blue on the map.

Total January precipitation was above normal for nearly the entire state, with totals amounting to between 130 and 300% of normal. Quillayute, for example, saw double its usual amount of precipitation with a record 30.78" (211% of normal). But that is an extreme example. In Pullman, nearly double (185% of normal) the usual precipitation represents a more manageable 3.36". There were parts of eastern WA that received below normal precipitation, however. Pasco in the Lower Columbia Basin received only 82% of normal precipitation (Table 2). The bull's eye of below normal precipitation in north central WA is caused by the low Omak measurement (68% of normal) which has a few missing days of data, and thus is likely an underestimate.



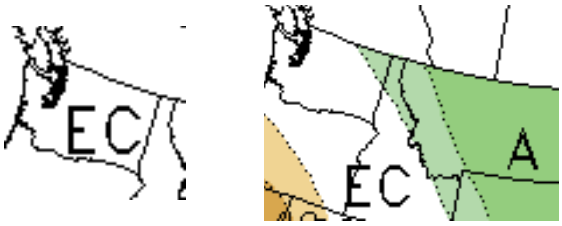
January temperature (°F) departure from normal (top) and precipitation percent of normal (bottom). (High Plains Regional Climate Center; relative to the 1981-2010 normal).

	Mean Temperature (°F)			Precipitation (inches)			Snowfall (inches)		
	Avg	Norm	Departure from Normal	Total	Norm	% of Norm	Total	Norm	% of Norm
Western Washington									
Olympia	42.9	39.8	3.1	15.56	7.84	198	M	1.9	-
Seattle WFO	44.2	42.1	2.1	7.96	4.81	165	3.8	0.4	950
SeaTac AP	45.0	42.0	3.0	9.23	5.57	166	0.7	1.4	50
Quillayute	43.0	41.6	1.4	30.78	14.61	211	M	2.0	-
Hoquiam	44.8	42.6	2.2	19.91	10.33	193	M	1.3	-
Bellingham AP	41.3	39.2	2.1	7.02	4.67	150	M	3.4	-
Vancouver AP	46.0	41.6	4.4	7.35	5.50	134	M	M	-
Eastern Washington									
Spokane AP	34.1	29.5	4.6	3.17	1.79	177	19.1	11.4	168
Wenatchee	31.6	29.5	2.1	1.11	1.06	105	M	12.9	-
Omak	30.1	26.8	3.3	1.28*	1.89	68*	M	M	-
Pullman AP	35.0	31.6	3.4	3.36	1.82	185	M	M	-
Ephrata	33.4	28.8	4.6	1.11	0.91	122	M	7.6	-
Pasco AP	40.8	34.9	5.9	1.00	1.22	82	M	0.4	-
Hanford	38.8	33.4	5.4	0.99	0.94	105	1.2	4.5	27

Table 2: January 2020 climate summaries for locations around Washington with a climate normal baseline of 1981-2010. *Omak, WA is missing precipitation values for 2 days of the month, potentially contributing to an underestimate of total monthly precipitation. 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.

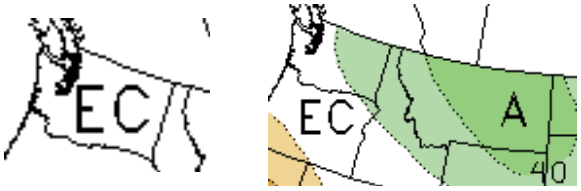
Climate Outlook

According to the Climate Prediction Center (CPC), neutral ENSO conditions are present in the equatorial Pacific. The warmer than normal sea surface temperature (SST) anomalies in the western equatorial Pacific have stayed more or less constant since last month's newsletter, but the SST anomalies have cooled in equatorial eastern Pacific. Still, the atmospheric patterns remain ENSO neutral. ENSO forecast models continue to show ENSO-neutral conditions persisting through spring and summer 2020.



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

The CPC February temperature outlook has equal chances of either below, equal to, or above normal temperatures statewide. The February precipitation outlook also calls for equal chances of below, equal to, or above normal precipitation for nearly the entire state, except for the extreme northeastern corner where there are elevated chances of above normal precipitation.



February-March-April outlook for temperature (left) and precipitation (right)

The CPC February-March-April (FMA) seasonal temperature outlook also shows equal chances of below, equal to, or above normal temperatures statewide. For precipitation, most of eastern WA has increased odds of above normal FMA precipitation. The rest of the state has equal chances of below, equal to, or above normal precipitation.

(Climate Prediction Center)