Office of the Washington State Climatologist

May 5, 2016

April Event Summary

Mean April temperatures were warmer than normal across the state, while precipitation was generally below normal. April had two periods of extremely warm temperatures (approximately April 7-9 and April 17-20) that helped drive the average monthly temperatures up, but minimum temperatures were also warmer than normal around the state for a majority of the month. April ranked as the warmest April on record for many locations (Table 1). The rest of the state was within the top 10% of warmest Aprils as shown in Figure 1, and numerous daily records were broken as well. For example, SeaTac Airport recorded a maximum temperature of 89°F on the 18th, which ranks as the warmest April temperature in Seattle history (including records back to 1894 downtown).

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Station	April Avg Temperature (°F)	Rank	Records Began
SeaTac AP	56.7	1	1945
Olympia AP	53.2	1	1948
Quillayute	51.9	1	1966
Bellingham AP	54.0	1	1949
Hoquiam	53.8	1	1953
Yakima AP	58.4	1	1946
Wenatchee Pangborn AP	59.2	1	1959
Colville	56.9*	1	1899
Spokane AP	54.7	2	1881
Ritzville	53.5	4	1916

Table 1: Average April temperatures, the ranking (warmest to coldest), and the period of record for selected WA sites. *4 days are missing from Colville, and there's also missing data for a large portion of the record in the 1950s-1990s.

The first interval of note began in association with a ridge of high pressure that developed on the 6th, bringing warmer than normal temperatures to the state from the 7th through 9th. During this period, there was some minor flooding on the Naches River near Yakima due to increased snowmelt. As for temperatures, there were daily record high temperatures broken in western WA on the 7th; examples include Vancouver (87°F), Olympia (80°F), and SeaTac Airport (78°F). Daily temperature records were broken in eastern WA on the 8th and 9th. For example, on the 9th Yakima (85°F), Wenatchee (78°F), and

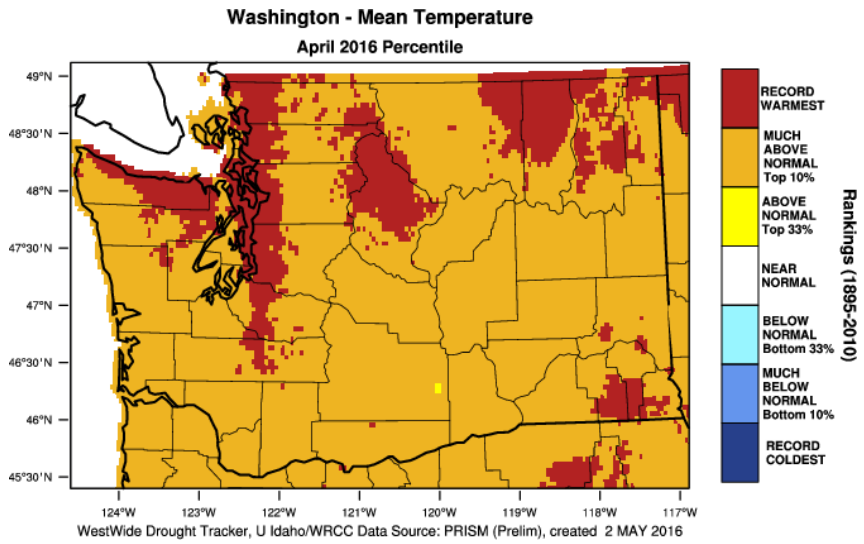


Figure 1: Average April temperature percentiles relative to the 1895-2010 record (WWDT).

Ephrata (77°F) set records. Normal April temperatures returned for the week of the 11th, and there were some showers throughout the state. The showers were mostly of moderate intensity, though there was a maximum daily rainfall record set at Wenatchee on the 15th of 0.50".

The second period of above normal temperatures began on the 16th with another ridge of high pressure building over the region. Temperatures were even warmer than earlier in the month, and daily maximum temperature records were set around the state from the 17th through the 20th. On the 18th, records were set at SeaTac Airport (89°F), the Seattle Weather Forecasting Office (89°F), Olympia (88°F), Vancouver (87°F), Bellingham (83°F), Quillayute (80°F), and Hoquiam (80°F). SeaTac AP recorded 4 consecutive days with temperatures 80°F or above, which is the earliest in the calendar year that has occurred on record. Some daily maximum temperature records were set in eastern WA on the 20th, and there were some minor flooding concerns from snowmelt; for example, Wenatchee (86°F), Spokane Airport (84°F), and Pullman (82°F) reached record daily high temperatures on the 20th.

Temperatures moderated for the remainder of the month, and showers returned for the weekend of April 23/24, with the heaviest precipitation in western WA, as usual. Walla Walla did record a maximum rainfall record on the 29th with 0.43", but otherwise the end of the month was relatively uneventful in terms of the weather.

Community, Collaborative Rain, Hail, and Snow (CoCoRaHS) Network

Thank you, CoCoRaHS volunteers, for continuing to read your rain gauges daily during the month of April. Your reports are an important contributor to education, weather forecast verification, and research applications. We encourage you to download the CoCoRaHS app - the developer who is none other than a fellow CoCoRaHS volunteer - to further optimize your reporting. CoCoRaHS Observer is available through the Google Play store and the Apple App store free of charge (links to each on the homepage: www.cocorahs.org). By far, word of mouth has been our greatest recruiting tool for our volunteer pool, so as always, please spread the word about CoCoRaHS in WA State!

Snowpack and Drought Update

The warm April temperatures caused a relatively rapid start to the melt of our snowpack. As of April 1, the snow water equivalent (SWE) was near-normal to above normal throughout the state. Figure 2 shows the SWE percent of normal averaged for each basin in WA as of May 2 from the Natural Resources Conservation Service. Due to faster melting than usual, the Upper Columbia, Spokane, Central Puget Sound, and Upper Yakima basins have SWE between 54 and 67% of normal. The North Puget Sound, Central Columbia, South Puget Sound, Lower Columbia, and Lower Snake basins are faring a little better, but still have below average SWE with values between 78 and 85% of normal. Finally, the Olympic and Lower Yakima basins have near-normal SWE with 96 and 91% of normal, respectively. One note on the Olympic Peninsula: the Dungeness gauge is already showing that the snow melted out, which for this time of year is normal, but melt out actually occurred in early April, which is about 3 weeks sooner than normal. The weekly U.S. Drought Monitor map as of May 3 shows some remaining "abnormally dry" in southwest WA based on both the longer-term indicators and the recent dryness (Figure 3). The turn to drier than usual conditions across the whole state is being closely monitored by both the Drought Monitor authors and the state's drought committee.

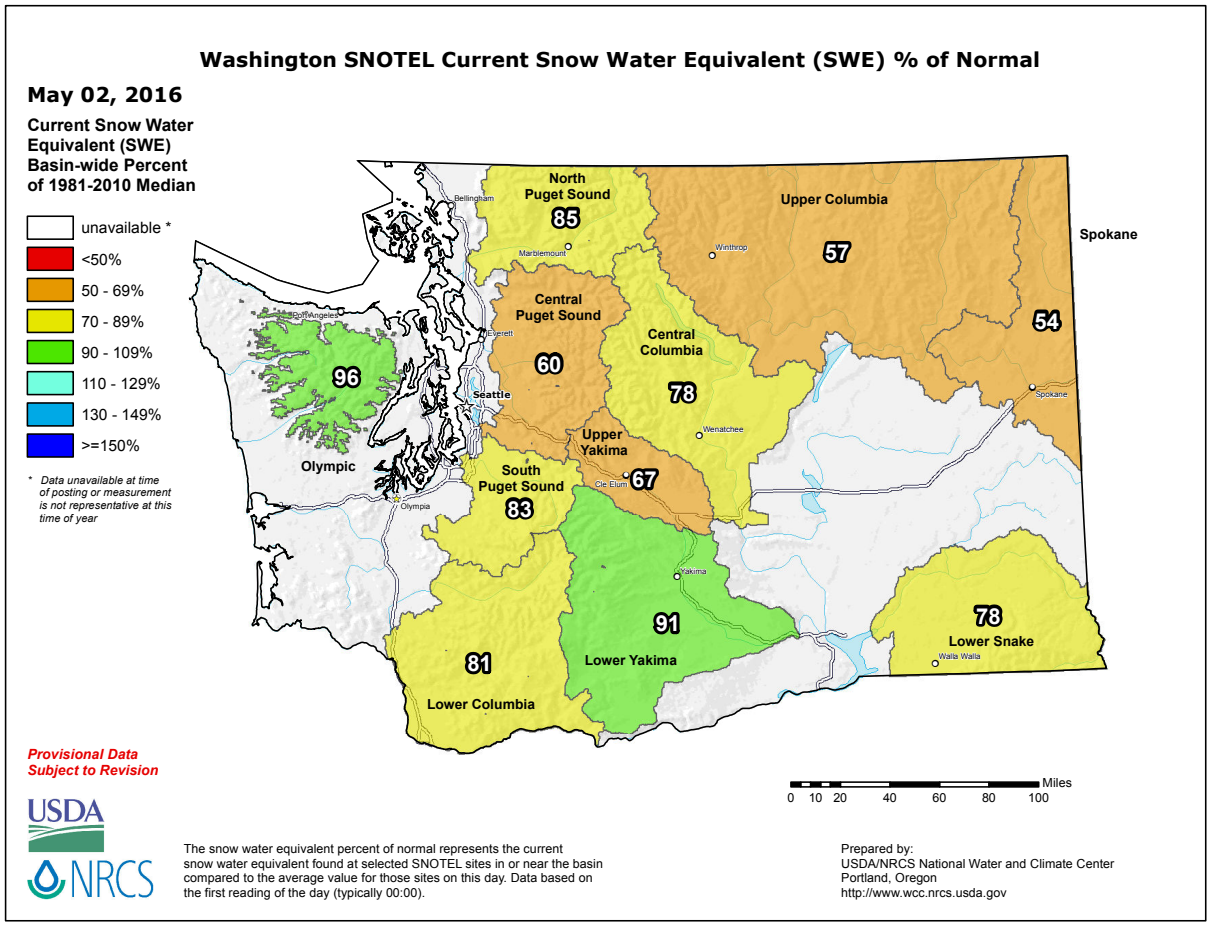


Figure 2: Snowpack (in terms of snow water equivalent) percent of normal for Washington as of May 2, 2016 (from the Natural Resources Conservation Service).

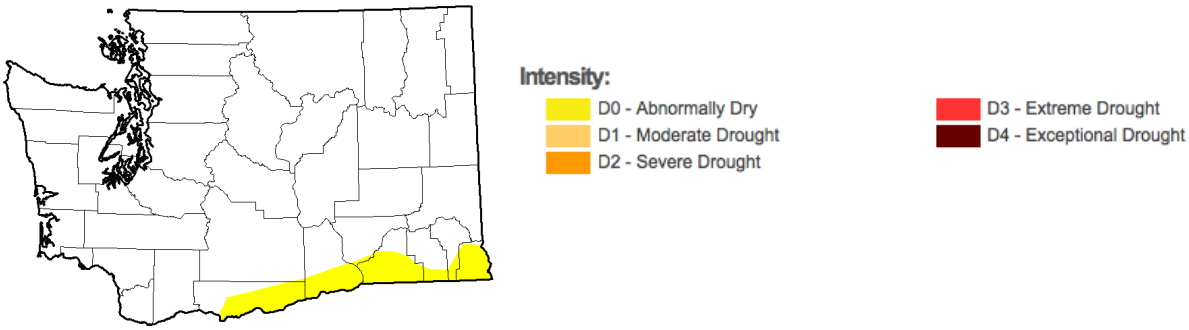


Figure 3: The May 3, 2016 edition of the US Drought Monitor (http://droughtmonitor.unl.edu/).

Introduction: New OWSC Assistant

We are pleased to introduce our new student assistant. An undergraduate at UW, Violeta Lio King is a junior currently pursuing a major in Atmospheric Sciences. She will be assisting OWSC with quality controlling precipitation data for CoCoRaHS, answering weather and climate data requests that come into the office, assisting in writing the monthly newsletter, and maintaining OWSC's social media presence. Welcome, Violeta!

The Pacific Decadal Oscillation: How much longer will it remain in the positive state?

A message from the State Climatologist

There is a close association between the short-term climate variability of the Pacific Northwest and the Pacific Decadal Oscillation (PDO). The PDO is fundamentally a mode or pattern of North Pacific sea surface temperature variability; Figure 4 shows the monthly PDO index since about 1970. It is becoming increasingly evident that the PDO is much more a *result* than a cause of fluctuations in the atmospheric circulation over the North Pacific and North America, as detailed in the recent review by Newman et al. (2016). Nevertheless, because it co-varies with a variety of atmospheric and oceanic properties, it provides a convenient, if by no means complete, means of characterizing the climate variability of the Pacific Northwest. Despite its name, the PDO actually fluctuates over a wide range of time scales. In other words, while it became strongly positive about two years ago, perhaps we should pay attention to current forecasts of the PDO.

Can changes in the PDO actually be predicted with much reliability? The short answer: to a certain extent. The PDO is largely controlled by the Aleutian low, with a stronger than normal and southeast-displaced Aleutian low associated with a positive trend in the PDO and a weaker and more westward Aleutian low with the negative phase of the PDO. Therefore

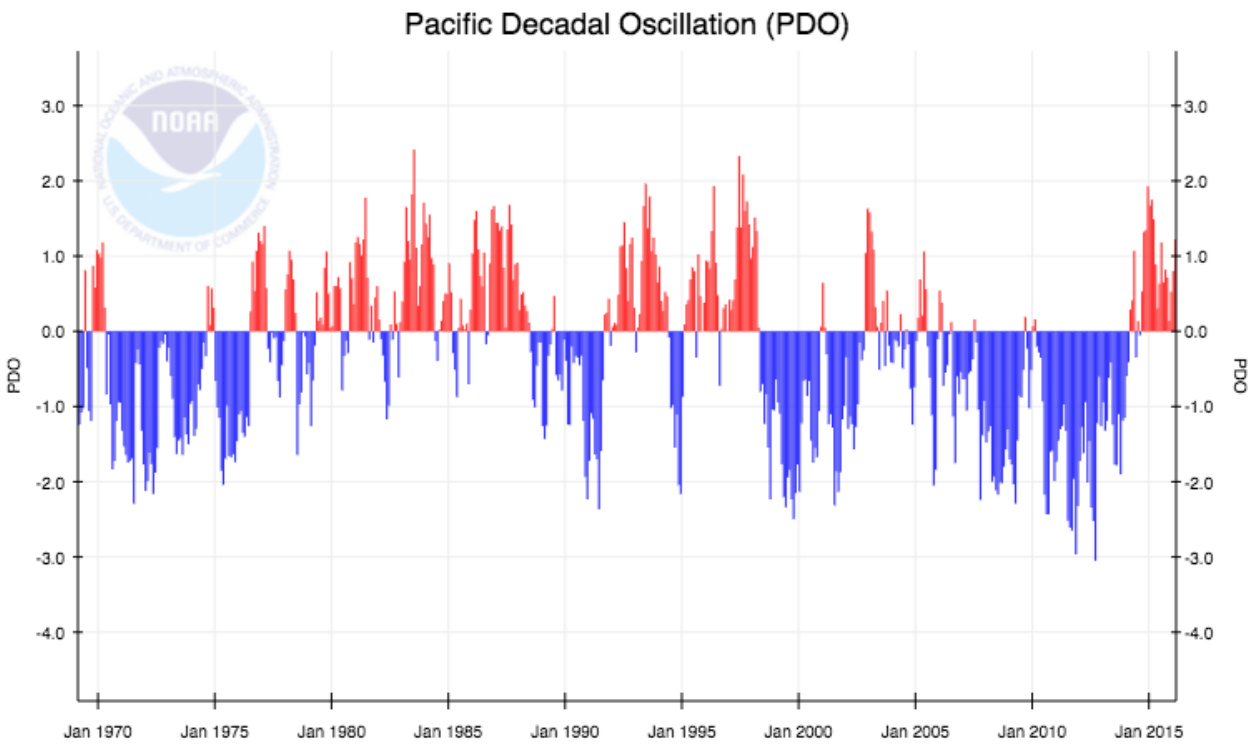


Figure 4: Monthly PDO index since about 1970 (NOAA).

prediction of the PDO requires proper handling of forecasts of the Aleutian low, which itself is related to ENSO. Models that have skill at ENSO prediction consequently have some success at anticipating changes in the PDO. An example is NCEP's Climate Forecast System (CFS) model. As shown in Figure A below from Wen et al. (2012), a comparison of forecasts with observations for the period of 1981 through 2007 indicates that the CFS is generally able to predict major shifts in the PDO. There is definitely a tendency for the model to play catch-up; as shown by the differences between the 3-month and 6-month forecasts, the CFS is often too slow in capturing major transitions in the PDO. Figure 5 pertains to PDO forecasts on a time horizon of up to 6 months. Additional research into the predictability of the PDO on time scales of a year and longer has been carried out, but this subject is not the focus of the present piece. Here it suffices to say that forecasts of the PDO beyond a year or two lack much if any skill, and that there appear to be fundamental limitations in long-term predictions of climate variations of this type.

Operational forecasts of the PDO from NOAA's Climate Prediction Center (CPC) are available online (http://www.cpc.ncep.noaa.gov/products/GODAS/) as part of a Monthly Ocean Briefing hosted by CPC. The latest forecast for the PDO, using the updated CFSv2 model, is shown in Figure 6. The ensemble of forecasts from March 2016 indicates a prominent negative trend in the PDO from spring into fall 2016, with an ensemble mean value slightly into negative territory. This set of predictions is consistent with the CFSv2 ENSO forecasts (and that of many other ENSO models) that La Niña conditions are more likely to develop than not in the tropical Pacific. Will this actually come to pass? Seasonal forecasts of ENSO are far from a solved problem. For example, the ENSO models as a group poorly forecast the winter

of 2014-15. On the other hand, the ENSO models for the winter of 2015-16 were spot on in their predictions of a very strong El Niño. La Niña, and a downturn in the PDO, appear probable, but only time will tell.

References

Newman, M. and Co-Authors (2016): The Pacific Decadal Oscillation, Revisited. *J. Clim.,* doi: http://dx.doi.org/10.1175/JCLI-D-15-0508.1

Wen, C.H., Y. Xue, and A. Kumar (2012): Seasonal Prediction of North Pacific SSTs and PDO in the NCEP CFS Hindcasts. *J. Clim.*, **25**, 5689–5710.

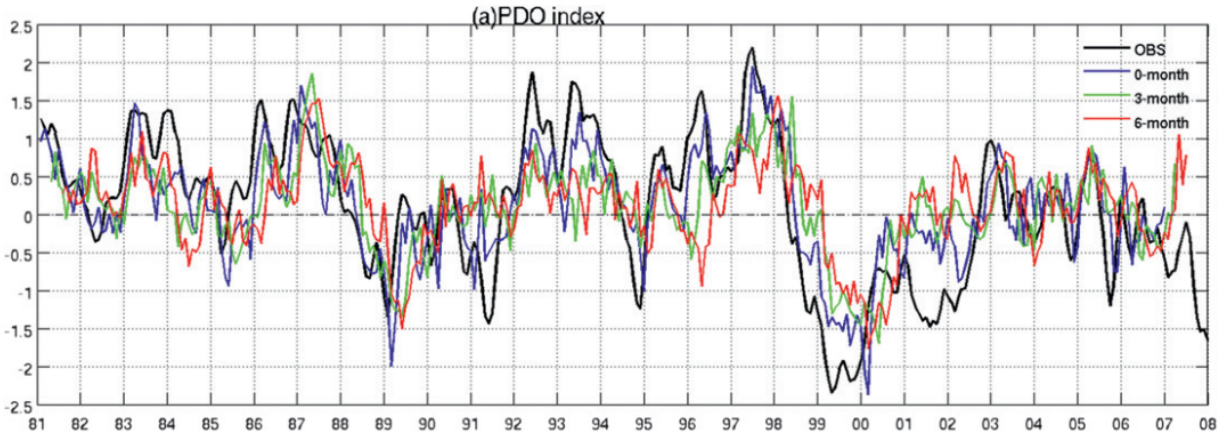


Figure 4: Observed values of the PDO versus CFS model forecasts at various lead times for the period of 1981 through 2007 (extracted from Wen et al. 2012).

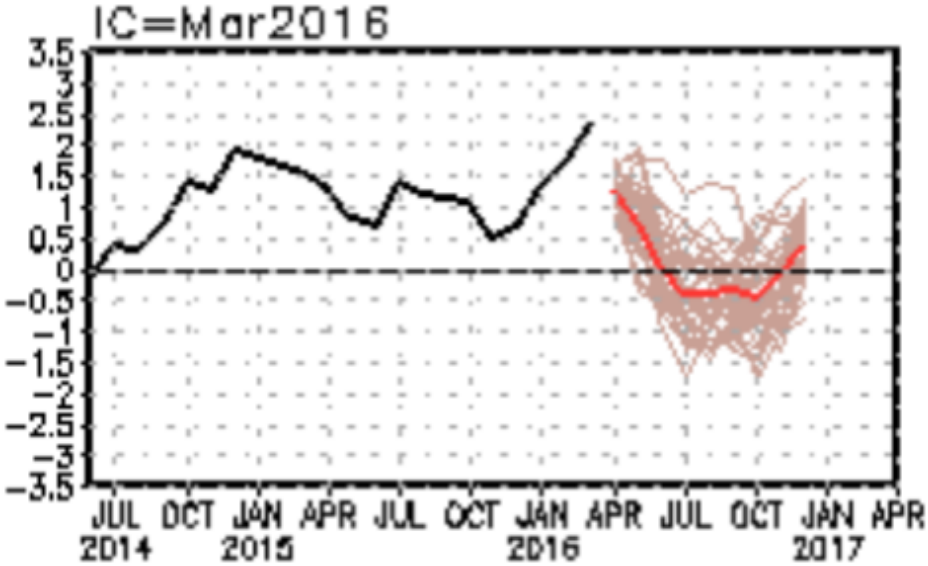
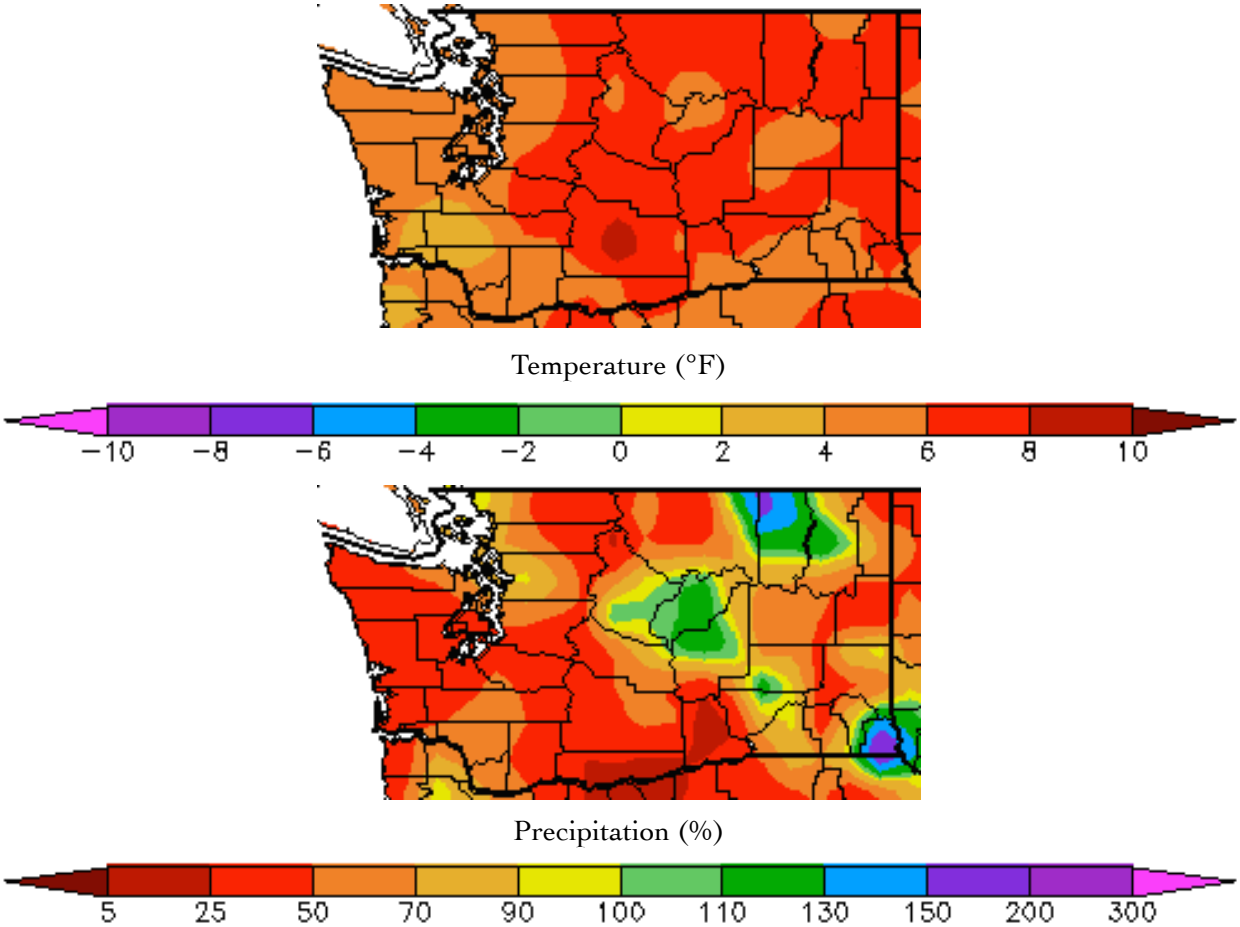


Figure 5: CFSv2 model prediction of PDO index based on March 2016 initial conditions. The bold, red line is the ensemble mean of each forecast, with the brown lines representing the 40 forecast members.

Climate Summary

Mean April temperatures were much warmer than normal for the entire state. The majority of the state was at least 5°F warmer than normal with parts of eastern WA more than 7°F warmer than normal, according to the map below from the High Plains Regional Climate Center. Olympia, Quillayute, and Pasco, for example, were 4.9, 5.1, and 5.6°F above normal, respectively, for the month (Table 2). Spokane was an especially warm spot, with average April temperatures 7.7°F above normal. On the other hand, Vancouver anomalies were on the lower end, with average April temperatures "only" 3.8°F above normal.

Total April precipitation varied across the state but was generally below normal. Relative to climatological normals, most of the state received only around 40 to 60% of normal. Spokane's 0.32" was 25% of normal, making it the lowest percentage of normal in the state locations sampled in Table 2. In contrast, Pullman was a wet spot with its 1.83" of precipitation being at 119% of normal. Locations like Bellingham and Wenatchee, however, were the exception in their monthly precipitation with near-normal levels at 91 and 109%, respectively.



April temperature (°F) departure from normal (top) and precipitation % 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	Percent of Normal
Western Washington						
Olympia	53.2	48.3	4.9	1.58	3.54	45
Seattle WFO	56.3	50.5	5.8	1.57	2.77	57
SeaTac AP	56.7	50.3	6.4	1.19	2.71	44
Quillayute	51.9	46.7	5.2	2.21	7.85	28
Hoquiam	53.8	48.7	5.1	2.68	5.10	53
Bellingham AP	54.0	48.4	5.6	2.44	2.69	91
Vancouver AP	55.9	52.1	3.8	1.77	3.01	59
Eastern Washington						
Spokane AP	54.7	47.0	7.7	0.32	1.28	25
Wenatchee	59.2	51.6	7.6	0.50	0.46	109
Omak	56.6	50.0	6.6	0.53	1.04	51
Pullman AP	52.2	46.1	6.1	1.83	1.56	117
Ephrata	57.5	50.4	7.1	0.55	0.48	115
Pasco AP	58.5	52.9	5.6	0.28	0.65	43
Hanford	61.0	53.4	7.6	0.34	0.55	62

Table 2: April 2016 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 NCDC's new normal release, as records for these station began in 1998 and 1986, respectively.

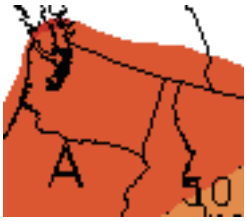
Climate Outlook

El Niño is still present in the tropical Pacific Ocean, according to the Climate Prediction Center (CPC). Sea surface temperature (SST) anomalies have been decreasing over the last 4 weeks, with the most-recent weekly SST departure from normal in the eastern tropical Pacific below normal (-0.3°C). While the "El Niño Advisory" that was released by CPC over a year ago is still in effect, El Niño is expected to continue to weaken. This spring, we've seen gradually decreasing tropical SST anomalies, and neutral conditions are expected by May-July. The chance of La Niña increases during late summer and early fall, and CPC has released a La Niña watch.

The CPC seasonal outlook for May is calling for higher than normal temperatures statewide, with the chances of warmer than normal temperatures exceeding 50 percent on a three-tiered scale. With regards to precipitation, the state has equal chances of below, equal to, or above normal precipitation for the month.

The May-June-July (MJJ) CPC outlook is the same as the May outlook: higher than normal temperatures are expected statewide. For precipitation, the state has equal chances of below, equal to, or above normal precipitation for MJJ.

May outlook for temperature (left) and precipitation (right) from the CPC.



May-June-July outlook for temperature (left) and precipitation (right) from the CPC.