Office of the Washington State Climatologist

June 2017 Report and Outlook

June 13,2017

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

May Event Summary

Mean May temperatures were slightly warmer than normal for WA state, despite a cool down period during the middle of the month. The general pattern of cooling and warming is exemplified by Figure 1 which shows the daily temperatures for SeaTac airport for May 2017. Precipitation was variable throughout the state, with most places receiving near-normal rainfall, though the Olympic Peninsula and eastern WA were on the drier side (see "Climate Summary").

The month started off with a spike in temperatures after a warm front moved through. Typical of springtime conditions, the weather pattern quickly shifted as a marine push fueled a series of thunderstorms and powerful gusts (up to 70-80 mph in mountain ridges) that swept through western WA and east of the Cascades. The rising temperatures and well-above normal snowpack also caused a marked surge in streamflows.

Mid-May was generally cooler and rainy. Several locations set daily precipitation records during this period: the Seattle Weather Forecasting Office (0.33"), Hoquiam (0.86"), and Olympia (0.77") on the 11th and Walla Walla (0.82") on the 16th. Figure 2 shows the 24-hr precipitation totals ending on May 12 at 7:00 am. Towards the end of the month, temperatures crept back up as a ridge of high pressure built over the area. On the 22nd, Seattle WFO reported a new record high temperature of 80°F. Walla Walla recorded a high temperature of 97°F on the 29th, which was not just a daily record but also the hottest May day since 1986.

In this Issue

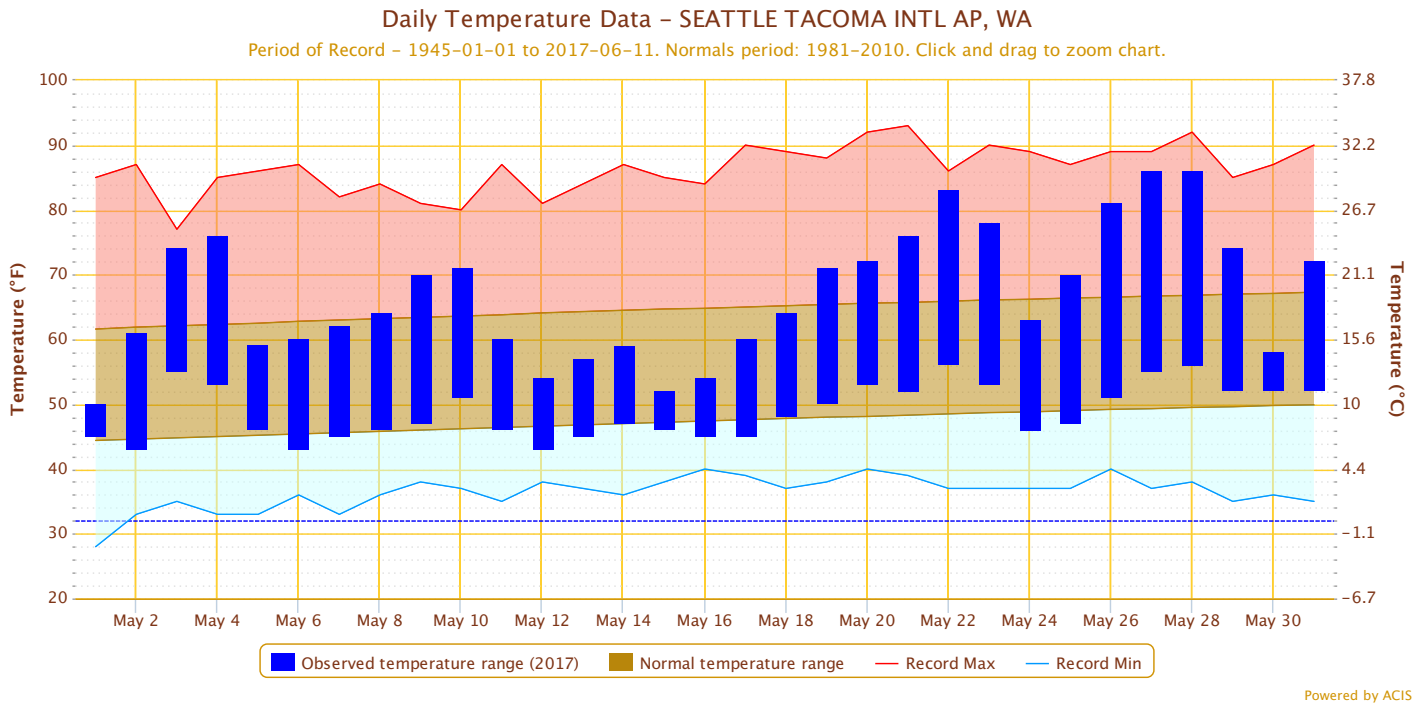


Figure 1: Daily high and low temperatures (blue bars) for the month of May 2017 at the SeaTac Airport compared to normal (brown envelope). The red and blue envelopes represent the daily records from other years.

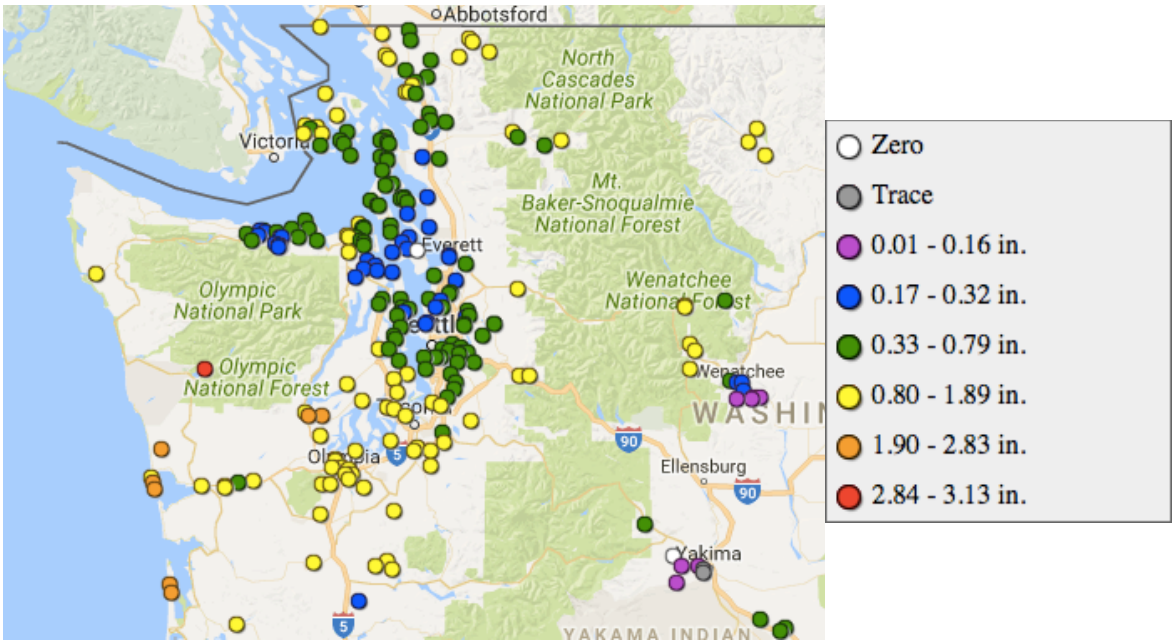


Figure 2: 24-hr precipitation totals measured on the morning of May 12, 2017. Observations come from the CoCoRaHS volunteer network.

Snowpack Update

The recurrent warm periods of last month caused considerable snowmelt but overall, the snowpack is much greater than normal for this time of year. Figure 3 shows the snow water equivalent (SWE) percent of normal as of June 1 from the National Resources Conservation Service (NRCS). Most of the basins are at least 130% of normal SWE while the Upper Yakima, and the South Puget Sound basins are closer to normal snowpack with 94% and 114% of normal SWE, respectively. At the time of this writing (June 10), snowpack for the Olympia, Upper Columbia and Lower Columbia basin were well over 200% of normal SWE (not shown).

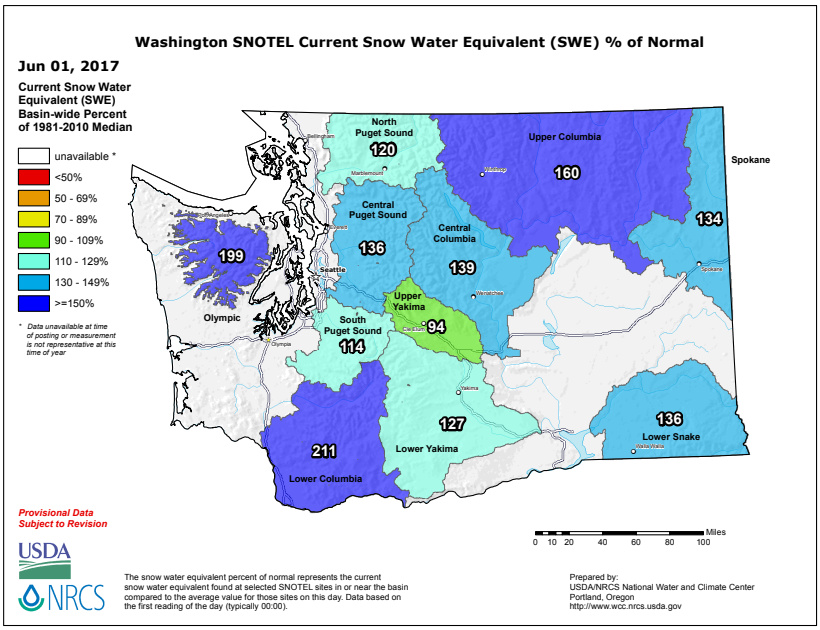


Figure 3: Snowpack (in terms of snow water equivalent) percent of normal for Washington as of June 1, 2017 (from the Natural Resources Conservation Service).

photo by Henry Reges, CoCoRaHS

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

Thank you to all of our CoCoRaHS volunteers for taking the time to read your rain gauges daily and reporting your observations. After such a wet winter and spring, the coming of summer also signals the arrival of what we typically think of as our dry period here in WA. While it can be a little mundane to report zeros day after day, those observations are just as helpful as days with rainfall. We're always looking for new volunteers, so help spread the word if you can. New volunteers can sign up and obtain training materials at www.cocorahs.org.

Are Springs Becoming Rainier in Washington State?

A message from the State Climatologist

It has been a wet spring in Washington state. The second half of May 2017 has actually been dry but that does not really make up for the drenching from March through mid-May. The wet weather was not just an inconvenience but represented some real issues for various sectors, notably agriculture in eastern WA. Whenever the weather is odd, which is much of the time, the Office of the Washington State Climatologist is asked why, and often whether climate change is responsible. The answer is usually "No". But in this case a glib answer is insufficient.

There does seem to be an overall trend towards wetter springs, specifically the months of March through May, in the Pacific Northwest. This is documented in Abatzaglou et al. (2014), which used station data to evaluate overall seasonal trends in temperature and precipitation for the years of 1920 through 2012. Figure 4 shows the mean trends in precipitation for the four seasons; note that spring has by far the most systematic signal over the years of 1920-2012. Because memories can be short (remember the dry spring and drought of 2015?) and precipitation has a great deal of inherent variability, we thought it might be interesting to pursue the subject a bit further.

The approach taken here is to consider the year to year variations in spring precipitation for WA as a whole. The time series shown in Figure 5 was extracted from NOAA's Climate at a Glance web site (https://www.ncdc.noaa.gov/cag/time-series),

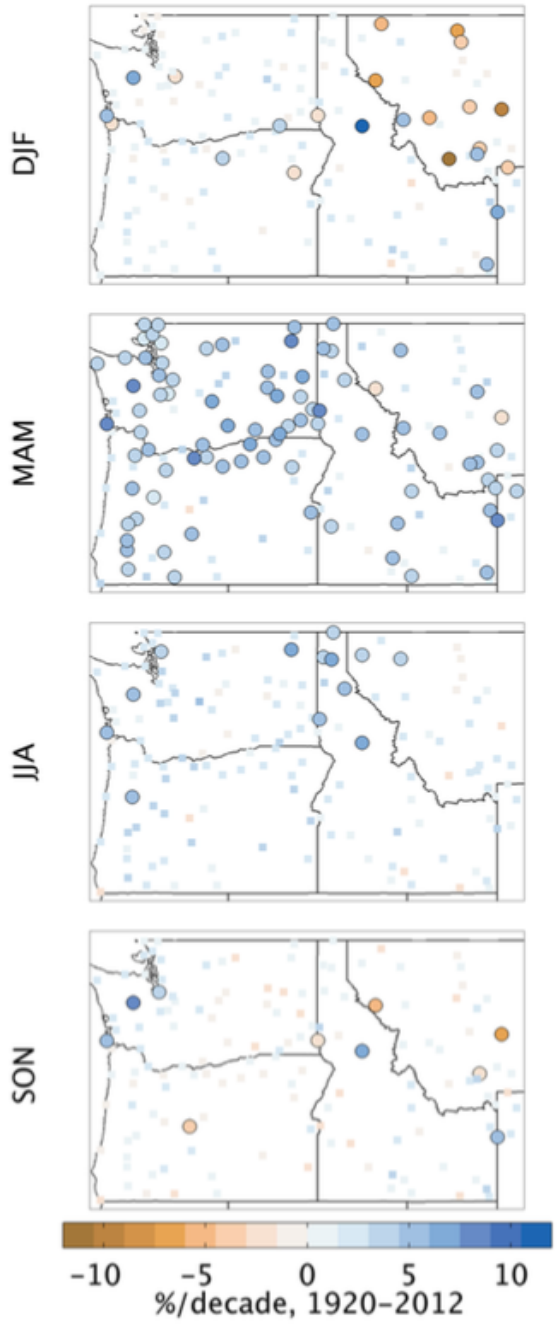


Figure 4: Linear trends in seasonal precipitation in the Pacific Northwest. Significant (p<0.05) trends are indicated with large circles, with brown and blue circles indicating decreases and increases, respectively, with the color scale at the bottom. Reproduced from Abatzaglou et al. (2014).

for the years of 1948 through 2017. The most obvious characteristic of this time series of precipitation is its large interannual variability. There is an upward trend, with the linear fit indicating an increase of a bit more than 2 inches over the 70 years. In general, the last couple of decades have had the wettest springs and none of the really dry years. OK, so it looks like it has gotten wetter, but why?

There are two possible ways this happened and that is through the dynamics or the thermodynamics, or some combination thereof. In other words, has the increase in precipitation been due more to greater upward motion or to higher atmospheric moisture contents? A rigorous assessment of this issue is way beyond the scope of the present piece, but thanks to atmospheric reanalyses, it is straightforward to arrive at some tentative conjectures. Towards that end, we considered time series of a few atmospheric parameters that could plausibly be linked to precipitation. An obvious one is the vertical velocity itself; plotted in Fig. 5 is a time series of the mean omega at 700 hPa for March through May for WA from the NCEP/NCAR Reanalysis. Negative values of omega mean upward motion and it is evident that the year to year variations in precipitation strongly correspond with those in omega (the correlation coefficient is about 0.86), as they should. In addition, there is a trend in omega towards decidedly more negative values

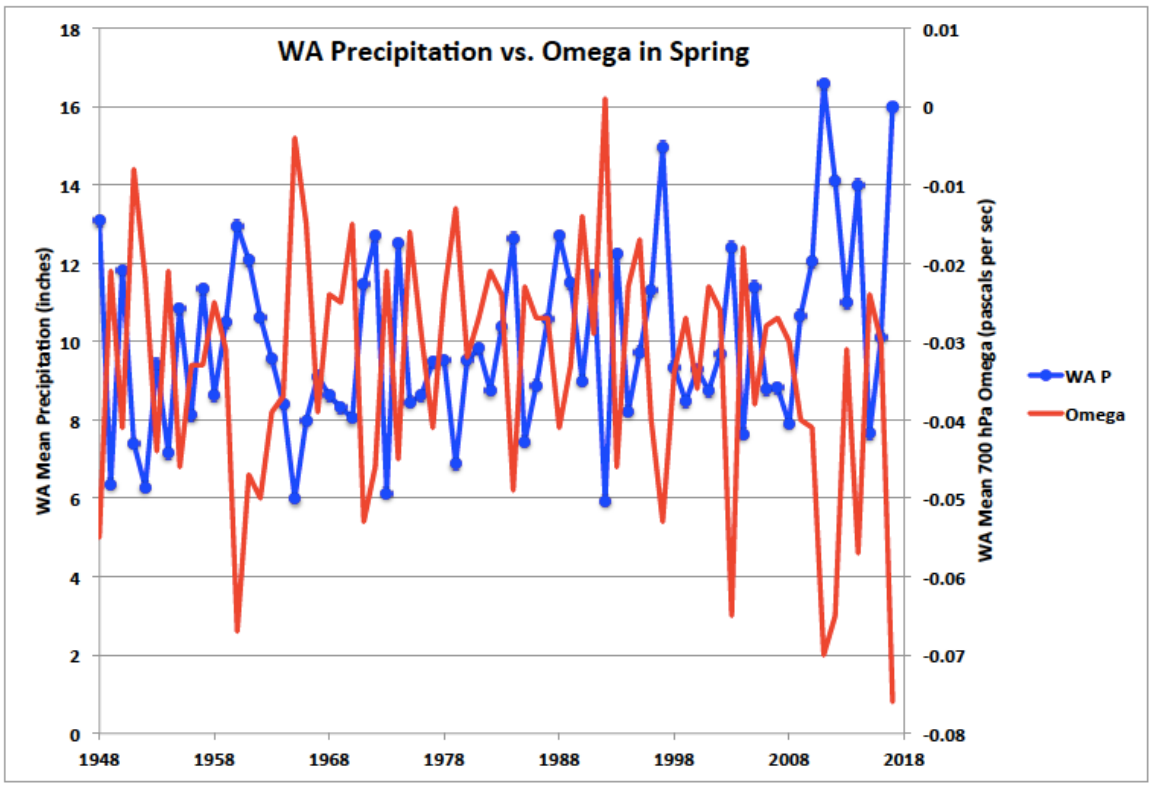


Figure 5: Time series of total precipitation in inches (blue dots and lines) and mean 700 hPa omega in Pa s^{-1}(red lines) for WA during the months of March through May for the years of 1948-2017. The value for 2017 reflects totals for March through May.

(upward motion) during the last 20 years or so amidst large interannual variations. A somewhat different result was found with respect to atmospheric humidity. Figure 6 shows the time series of specific humidity for WA state at the 925 hPa level, which represents a measure of atmospheric boundary layer moisture content. The year to year values in this parameter have essentially zero correlation (r ~0.03) with corresponding mean precipitation totals. But there is a positive trend with time, with the linear fit equivalent to an increase of about 0.24 g kg-1 over the 70-year period. Based on a scaling of the terms in the seasonal mean moisture budget, it appears that the increase in precipitation can be attributed primarily to the change in vertical motion, with the increased water vapor content playing a secondary role. We hasten to add that a much more thorough analysis would be required to establish that result with confidence. A continuation of higher atmospheric moisture contents seems likely as the climate warms. So unless the dynamics become less favorable in the future, which is quite possible, we should expect more wet springs. All the more reason to celebrate rather than curse the rain.

Reference:

Abatzoglou, J., D. Rupp, and P. Mote, 2014: Seasonal climate variability and change in the Pacific Northwest of the United States. J. Climate, 27, 2125-2142, doi:10.1175/JCLI-D-13-00218.1.

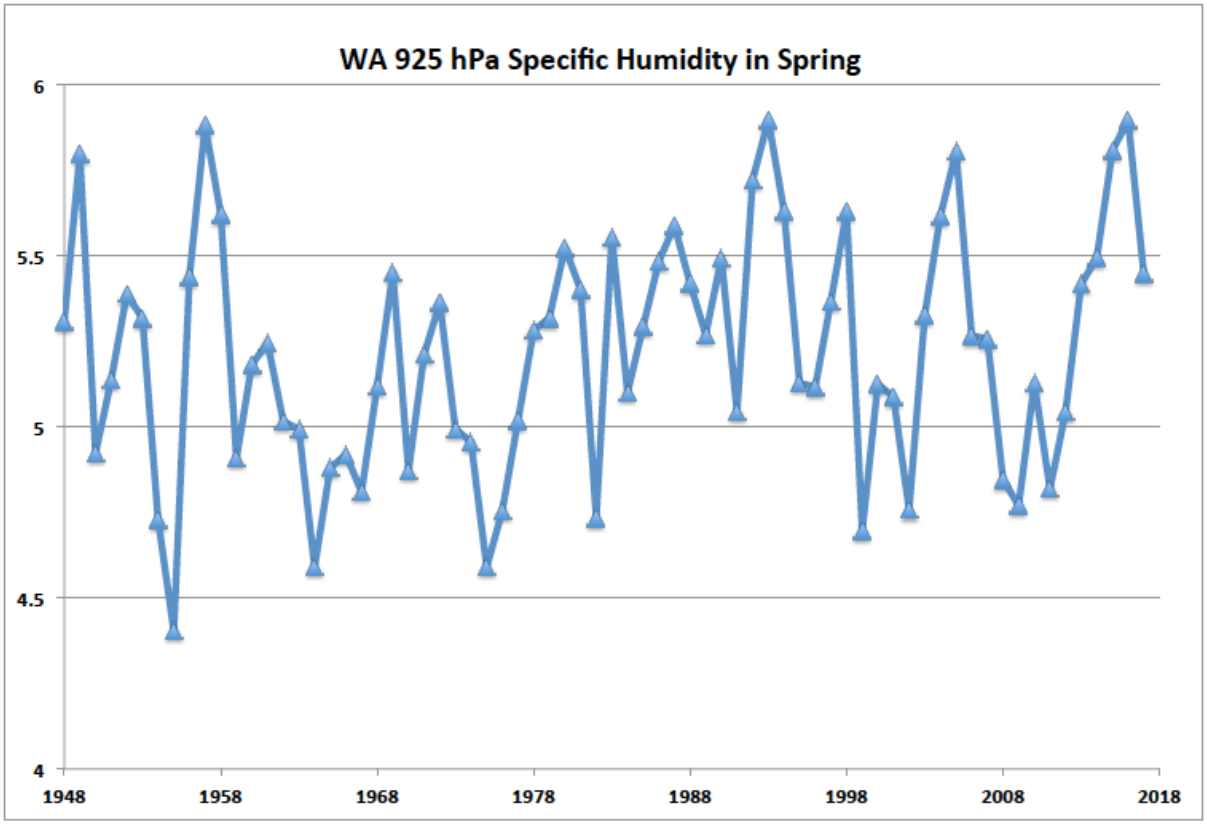
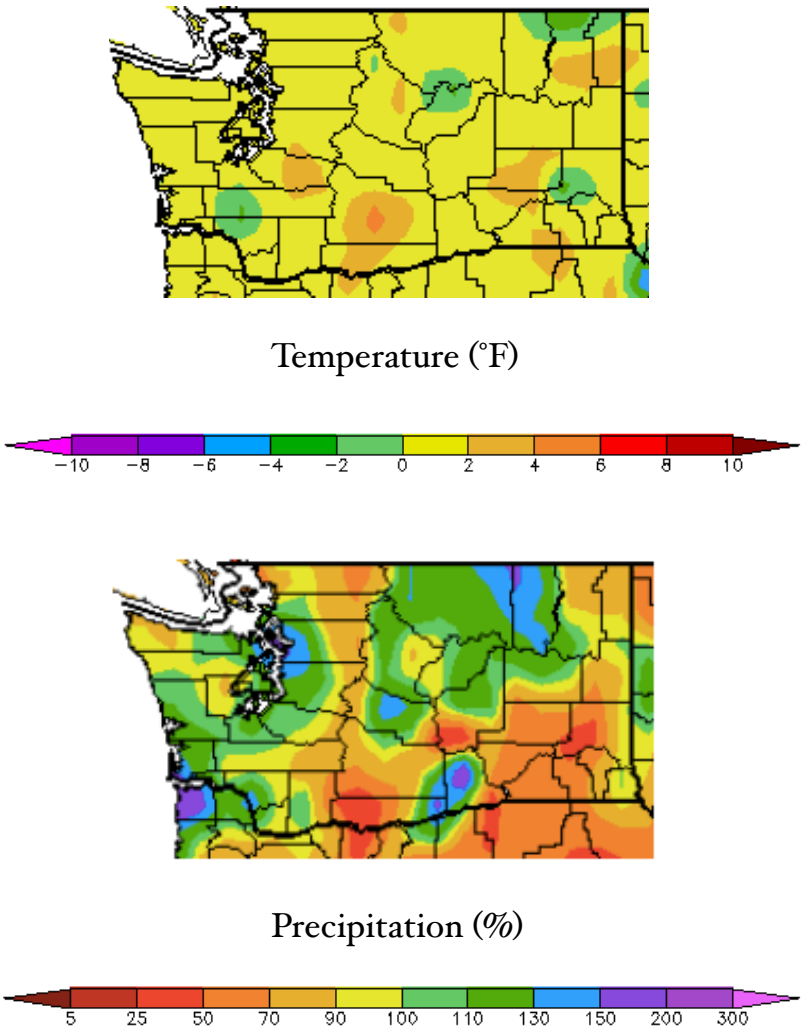


Figure 6: Time series of mean 925 hPa specific humidity (g kg^{-1}) for WA during the months of March through May for the years of 1948-2017.

Climate Summary

Mean May 2017 temperatures were between about 2°F above normal for most of WA State, as seen in the High Plains Regional Climate Center (HPRCC) temperature departure from normal map. Most locations were near normal: Relatively speaking, Hoquiam, Pasco and Wenatchee were all less than 1°F above normal There were a few warm spots, however. Seattle WFO, was 2.1°F above normal (Table 1) and some places on the map were up to 4°F warmer.

Total May precipitation varied across the state. Northern central WA and the Puget Sound area were some of the wettest spots with totals ranging from 130 to 150% of normal. As seen in Table 1, Olympia and Omak received 132 and 128% of normal, respectively. In contrast, northern Olympic Peninsula and eastern WA were comparatively drier, with most locations receiving about 70% of the climatological normal.



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	Normal	Departure from Normal	Total	Normal	% of Norm
Western Washington						
Olympia	55.9	54.2	1.7	3.07	2.33	132
Seattle WFO	58.1	56.0	2.1	3.15	2.16	146
SeaTac AP	57.9	56.0	1.9	2.28	1.94	118
Quillayute	52.1	51.3	0.8	5.15	5.11	101
Hoquiam	53.4	53.0	0.4	3.85	3.29	117
Bellingham AP	55.6	53.8	1.8	M*	2.48	M
Vancouver AP	59.6	58.1	1.5	1.79	2.47	72
Eastern Washington						
Spokane AP	57.0	55.1	1.9	1.31	1.62	81
Wenatchee	60.2	59.8	0.4	0.61	0.68	90
Omak	59.1	58.1	1.0	1.53	1.22	125
Pullman AP	54.8	53.2	1.6	1.99	1.56	128
Ephrata	60.9	59.3	1.6	0.76	0.65	117
Pasco AP	61.3	60.7	0.6	0.48	0.73	66
Hanford	63.0	62.1	0.9	0.37	0.51	73

Table 1: May 2017 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. "M" denotes missing data.

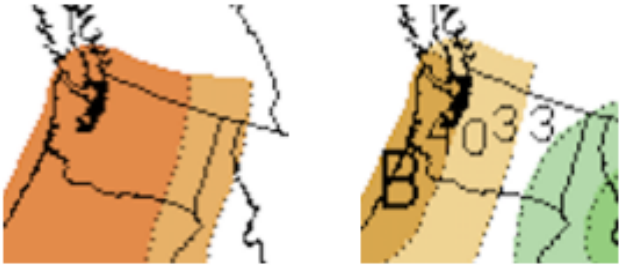
***The precipitation values for the Bellingham station were omitted due to the discovery that its precipitation gauge was underreporting for part of May and was therefore not reflective of the climate record.**

Climate Outlook

ENSO-neutral conditions are still present in the equatorial Pacific, according to the Climate Prediction Center (CPC). In the last 4 weeks, sea-surface temperatures (SSTs) have been slightly above normal in the western and eastern Pacific Ocean while remaining near-normal in the central Pacific. Current models are indicating about equal chances of continuing neutral conditions (55%) or an El Niño (45%) developing in summer and fall 2017.

The CPC outlook for June has increased chances for higher than normal temperatures statewide, with the greatest chances for warmer temperatures in western and central WA. Precipitation is less uniform. Most of eastern WA has equal odds of below, equal to, or above normal precipitation. June precipitation is expected to be below average for the rest of WA, especially west of the Cascades.

The CPC 3-month seasonal outlook for summer (June-July-August; JJA) is calling for higher than normal temperatures statewide, with the highest odds in the southwestern half of the state. JJA precipitation, on the other hand, is a toss-up - the outlook indicates equal odds of below, equal to, or above normal precipitation for the whole state.



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

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