Office of the Washington State Climatologist

May 4, 2011

April Showers...

...bring May flowers, or so we hope. For most of the state, April was cold and wet. The average April temperature at SeaTac International Airport tied as the 2nd coldest (45.5°F) with 1948 and 1954 in the 64 year record. The average April temperature at Spokane International Airport (41.5°F) and Olympia (43.7°F) also ranked as the 2nd coldest in the 131 year and 63 year record, respectively. The April mean temperature was the 5th coldest at Pullman 2 NW (41.5°F) in 71 years and the 6th coldest for the Vancouver COOP station (45.9°F) in 115 years. Precipitation also ranked in the top ten for several of those stations. Total 2011 April precipitation ranked as the 4th wettest for SeaTac (4.47") and Pullman (2.88") and the 7th wettest for Vancouver (4.65"). The total precipitation for April did not rank in the top ten for Spokane or Olympia. A summary of notable weather events for April follows.

In this Issue

The flooding that impacted the state at the end of March continued into April as heavy rain fell on April 1, especially in western WA. Daily rainfall records were set at SeaTac Airport (1.13") and at the Seattle Weather Forecasting Office (0.79"), and Figure 1 shows the total 24-hour precipitation ending on April 2 at 7 am. The wet pattern continued, and heavy snow fell in the mountains on the 5th and 6th with fairly low snow levels (500-1000 ft) for the time of year. Western WA lowland snow fell in several locations such as the Puget Sound convergence zone region of Snohomish County on April 6 & 7. Those few days of the month were particularly cold with a low high temperature record set at Stehekin (37°F) on the 6th, low minimum temperature records set at Pullman Airport (24°F) and Yakima (20°F) on the 7th, and a low minimum temperature record set at Walla Walla (30°F) on the 8th. Those cool temperatures were partially influenced by a ridge that built over WA on the 8th and part of the 9th, offering a fleeting respite from the rainy weather. Another break in the wet pattern occurred on the 12th, but it again did not last last long before low pressure systems continued to impact WA.

The week of April 17 was marked by numerous scattered showers and abundant convergence zone precipitation in western WA. Snow showers affected south central WA on the 20th and the Spokane area on the 21st. Daily record low temperatures were measured at Quillayute (28°F) and Hoquiam (32°F) on April 20. Another much-needed break in the cool and wet weather came on the 22nd and the 23rd as the region dried out. Figure 2 illustrates just how

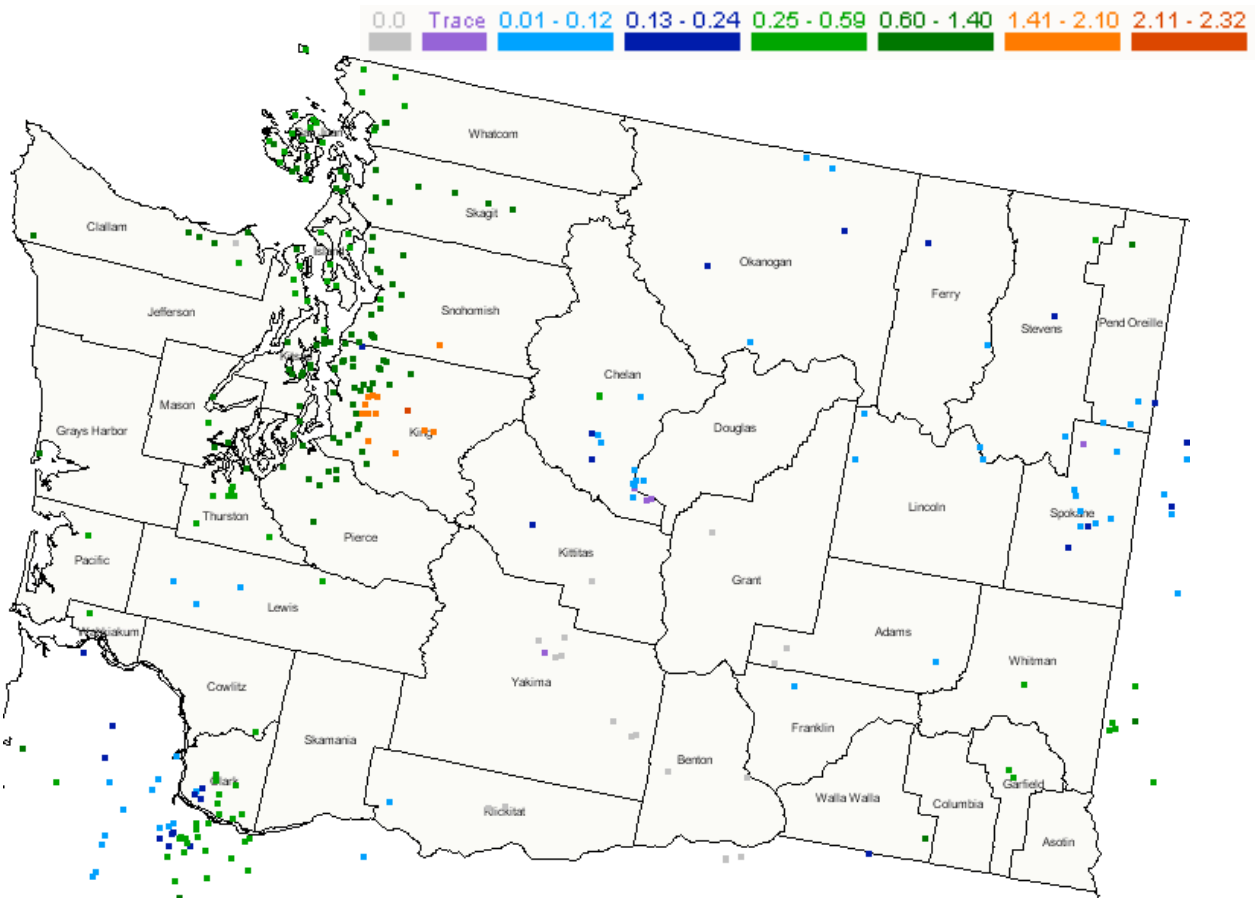


Figure 1: 24-hour total precipitation measured at 7 am on April 2, 2011 by CoCoRaHS Observers.

much of an aberration the temperature was in the Seattle area on the 23rd. It was the only maximum temperature that was above normal at SeaTac for the entire month. A daily record high temperature of 69°F was set at the Seattle WFO on that day as well. Another strong frontal system moved through on April 25, however, bringing late season snow to the mountains and setting some daily rainfall records around the state. For example, SeaTac, Spokane Airport, and Vancouver all set daily precipitation records on the 25th with 0.52", 0.63", and 0.69", respectively.

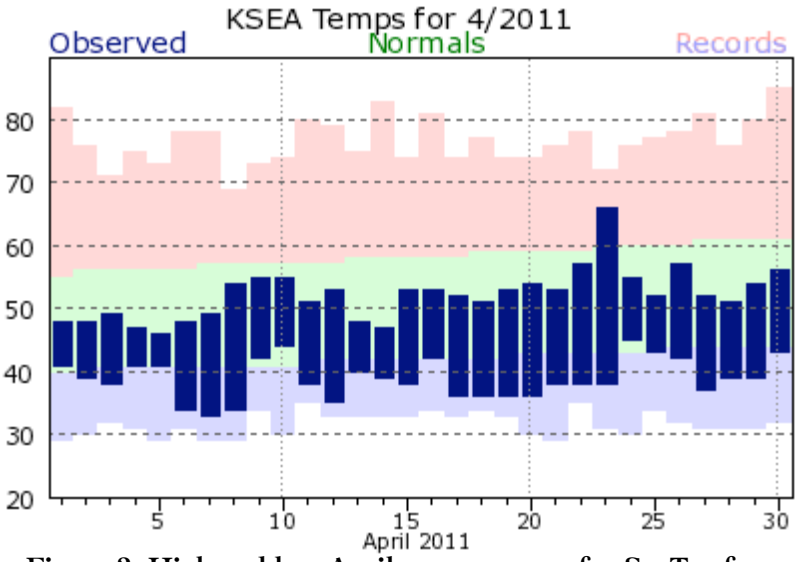


Figure 2: High and low April temperatures for SeaTac from the National Weather Service. Note the consistent below normal temperatures except for the warm anomaly the 23rd.

Snowpack & Projected Streamflow

The cool and wet conditions during April and earlier this spring have contributed to a snowpack that is much higher than normal. Figure 3 shows the percent of normal snow water equivalent (SWE) for 11 WA basins from the National Resources Conservation Service as of May 3, 2011. The Olympic, Central Puget Sound, Lower Columbia, Upper Columbia, and Lower Snake basins all have snowpack that is greater than 150% of normal. The other basins in the Cascades range between 117 and 145% of normal. The Northwest River Forecast Center issued their most recent water supply forecast on April 27 for projected streamflow from now through September (Figure 4), and is expecting normal (90-110%) to much above normal (125-150%) streamflow.

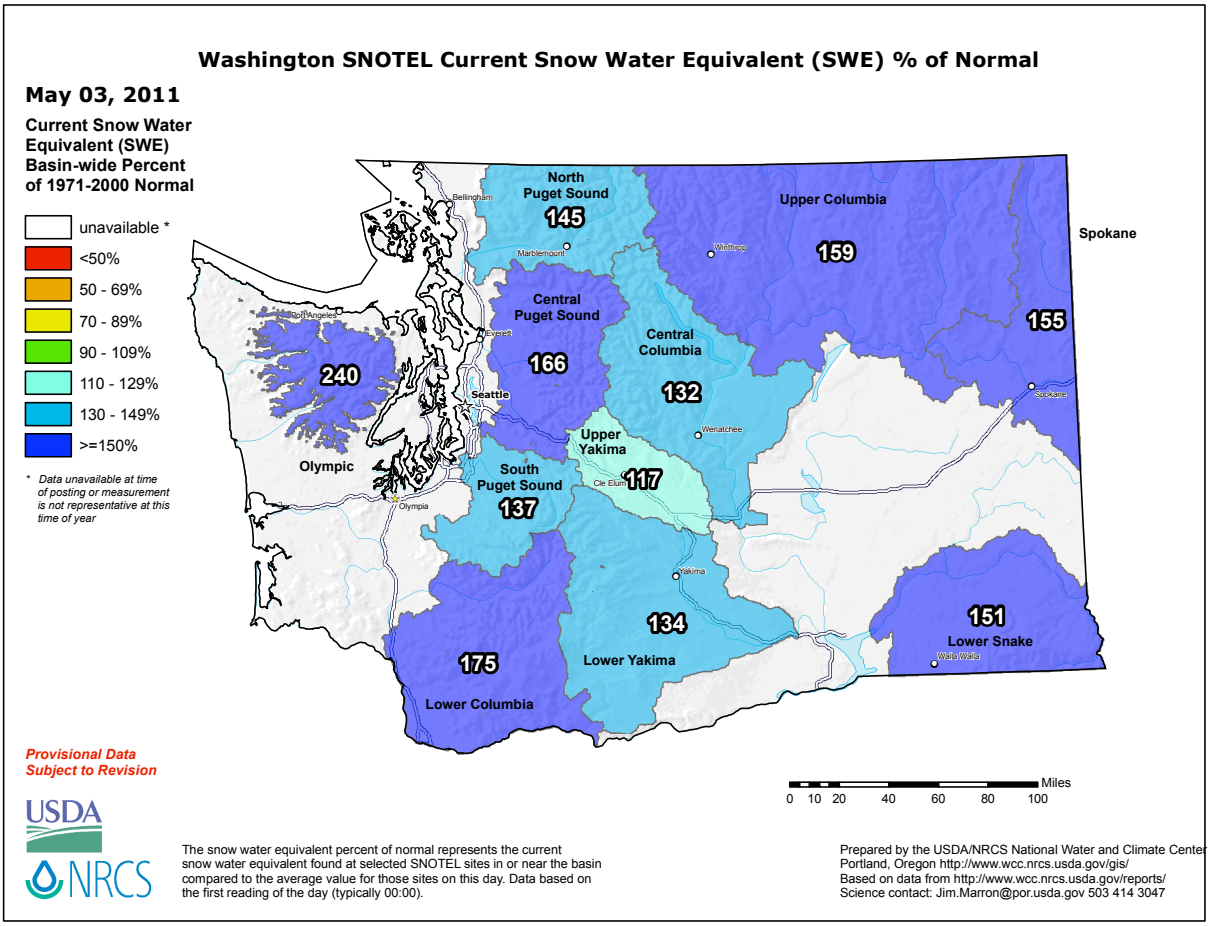


Figure 3: Snowpack (in terms of snow water equivalent) percent of normal for WA as of May 3, 2011 (from NRCS).

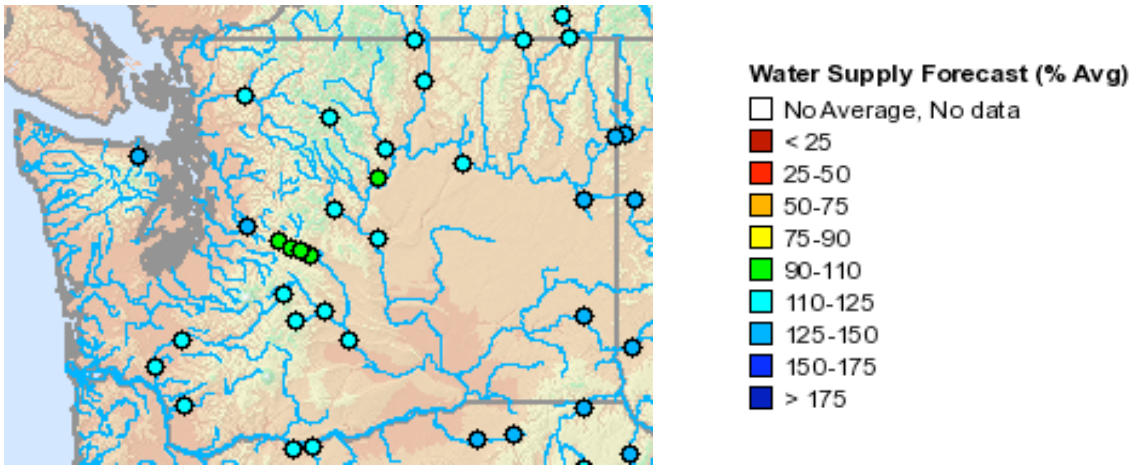


Figure 4: May through September water supply forecast for WA as of April 27, 2011 from the National Weather Service Northwest River Forecast Center (http://www.nwrfc.noaa.gov/water_supply/ws_fcst.cgi).

What is Spring?

A message from the State Climatologist

As summarized in this newsletter, it was a remarkably cool and wet April for Washington state. All the grumbling about the lousy weather, in particular the common lament that it seemed like winter was never going to end, begs an interesting question. When does spring normally occur in the state? Aside from the astronomical definition based on the length of day, there is no simple and easy answer. In other words, there are a variety of reasonable ways to define spring, or any other season for that matter, depending on one's interests and perspectives.

For the public in general, it may depend on location. Residents of the wetter west side of the state probably care more about how often it rains, while perhaps those subject to the more continental weather to the east of the Cascade Mountains are more impacted by temperatures. By the first of these measures, the Puget Sound region typically experiences a decline in frequency of rainy days in early March (as illustrated in Figure 5 using data from SeaTac), which therefore could be considered the beginning of spring. The average frequency of measurable rain decreases more or less steadily to its minimum at the end of July so there is no clear indication of a transition from spring to summer in this parameter. By way of comparison, the means and extremes in daily temperatures from Spokane (Figure 6) may suggest that spring starts near the end of March, when mean low temperatures rise above freezing, and mean high temperatures reach the mid-50s. Similar logic suggests that the last week of May marks the end of spring at this location because by that time of year daytime high temperatures average near 70 degrees and it is possible to get truly hot days with high temperatures in the upper 90s. Another potential measure is the percentage of possible sunshine, i.e., cloudiness. This may be especially meaningful west of the Cascades, where even though it typically rains more in May than in June, the latter month tends to include plenty of days with persistent decks of stratus clouds. In other words, perhaps spring on the west side

extends from when it starts raining less in March until the sun shines more consistently in July; on the east side spring arguably is half as long, with the months of April and May separating the chill of winter from the heat of summer.

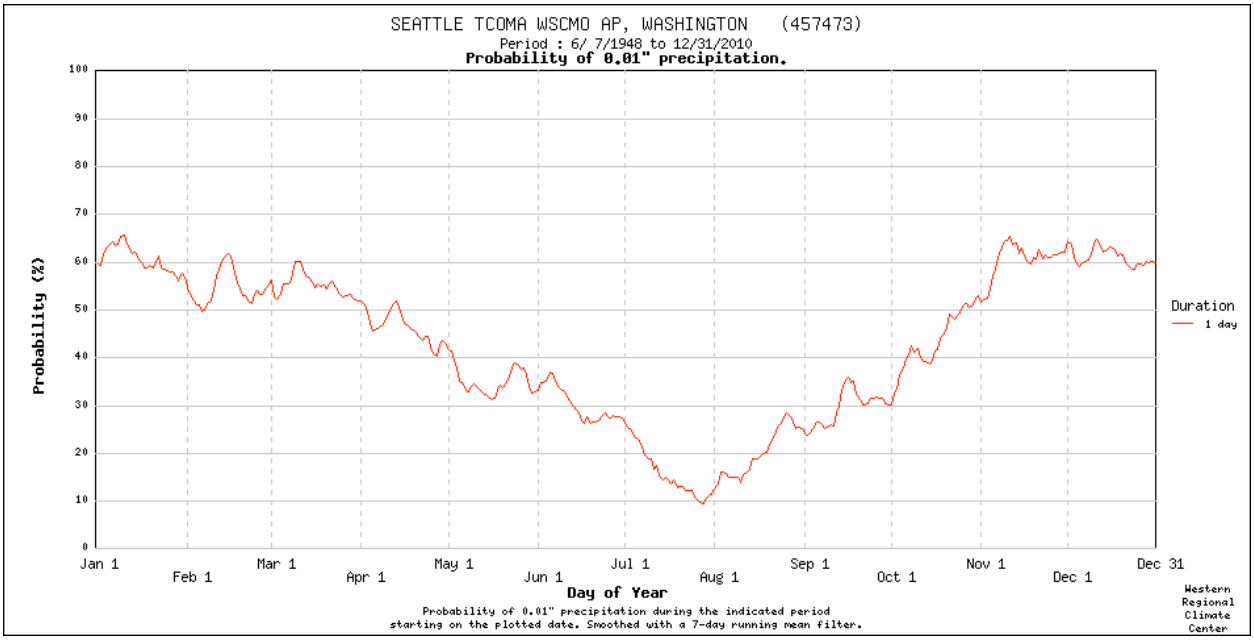


Figure 5: The daily probability of greater than 0.01" of precipitation using the period of record at SeaTac (from WRCC).

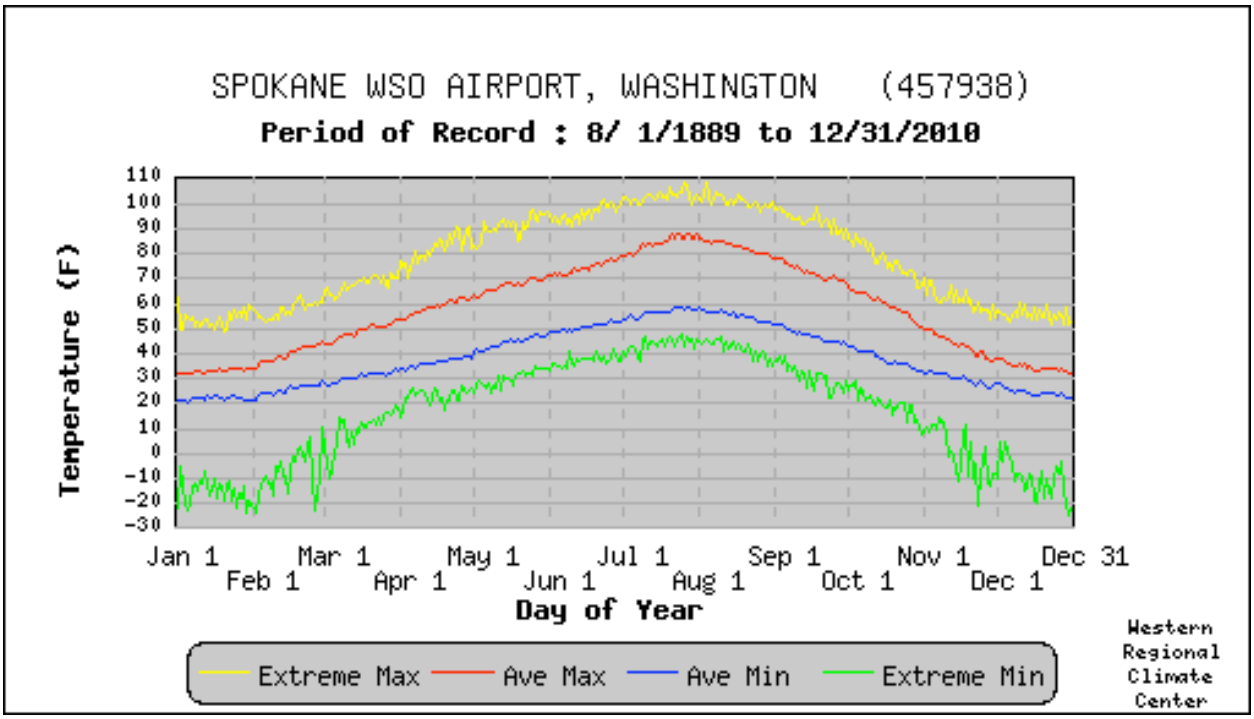


Figure 6: The daily max, min, and extreme temperatures for Spokane Airport using the period of record (from WRCC).

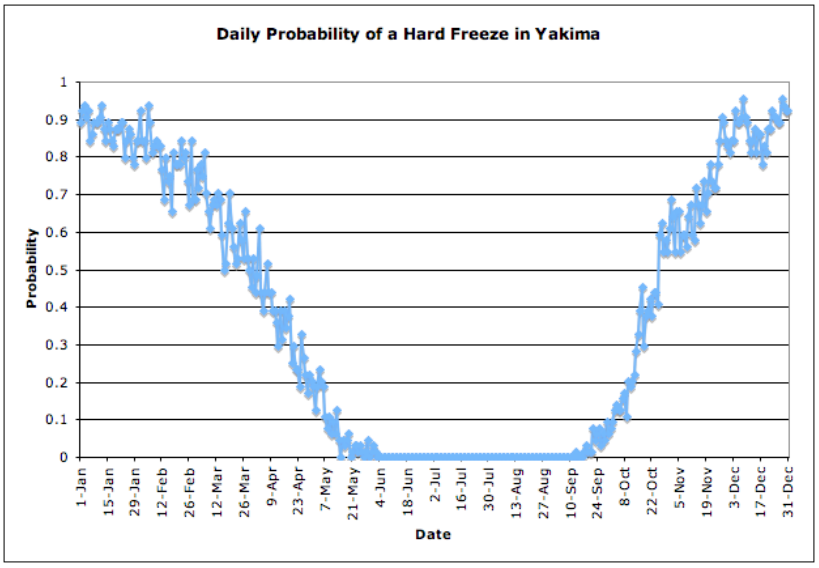


Figure 7: The daily probability of freezing temperatures in Yakima using the period of record.

The idea that spring is shorter east of the Cascades has some support from an agricultural point of view. The daily probability of a hard freeze in Yakima (Figure 7) decreases from about 50% at the beginning of April to near zero at the end of May. As an aside, it bears emphasizing that frosts can be a big deal. Unseasonably late frosts in spring, or early frosts in autumn, can cause multi-million dollar losses for vintners and orchardists, and some years represent the costliest weather events for the state as a whole.

Another facet of spring for our state, and one that may not be widely appreciated, is the reversal of the prevailing winds along the coast. The winter is characterized by winds generally out of the south, with intermittent northerlies. Summer tends to be accompanied by winds with a northerly component, especially during fair weather. This seasonality in the winds is important to the marine ecosystem because the northerlies of summer force the upwelling of water from depth in the coastal zone, and the higher concentrations of nutrients in this upwelled water are key to the growth of the plankton forming the base of marine food web. On average, the winds strongly favor coastal downwelling during November through February and undergo a slow transition to upwelling, with a peak in July (Figure 8). Therefore the mean winds also indicate that spring is prolonged for the western portion of the state. Finally, a variety of other parameters, such as snowpack, could be used to define the seasons. Some might just be connected to the weather, with an important example being streamflow. The seasonal cycles of these parameters naturally depend on type and place. In closing, we would like to point out that this spring's weather at least in part can be considered a sort of hangover from the past winter's La Niña. These effects typically do not extend into summer. So don't despair, eventually you will be able to pack away your long-johns.

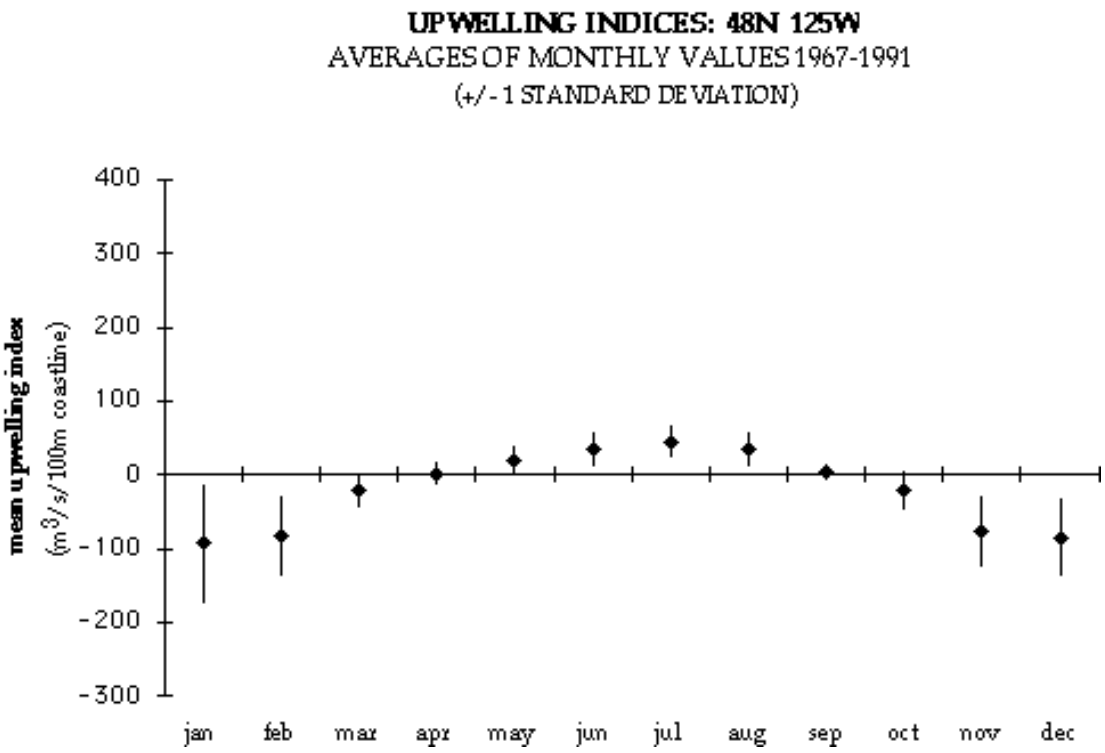


Figure 8: The annual cycle of upwelling and downwelling off of the WA coast using data from 1967 through 1991 (from NOAA's Pacific Fisheries Environmental Lab).

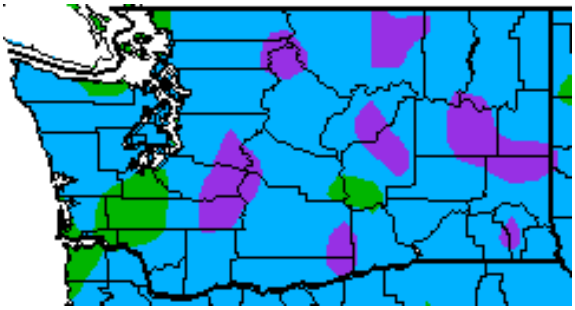
Pacific Northwest Weather Workshop

The Pacific Northwest Weather Workshop will be held on Friday and Saturday, May 13 & 14 at the NOAA Sandpoint Facility. The workshop will address a variety of topics relating to the weather and climate of the Pacific Northwest that may be of interest to our newsletter readers. A presentation on recent work OWSC has collaborated on with the Oregon Climate Service will also be given. For more information on the workshop, and to register, please visit: http://www.atmos.washington.edu/pnww/.

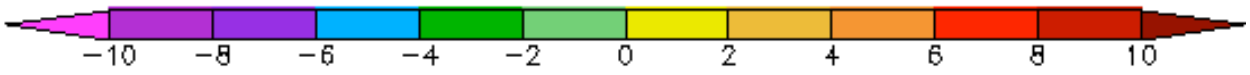
Climate Summary

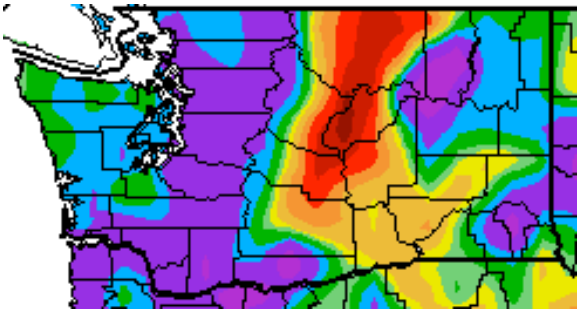
Temperatures across WA state were extremely cool during April. The High Plains Regional Climate Center (HPRCC) map below shows the temperature departures from normal between 4 and 8°F for the majority of the region. The largest departures from normal listed in Table 1 are from Ephrata and Omak, which were 6.6 and 6.1°F below normal, respectively.

Total April precipitation was above normal for western WA, with precipitation in areas east of Puget Sound and the western slopes of the Cascades at nearly 200% of normal (SeaTac and Vancouver had 173% of normal; Table 1). Northeastern and southeastern WA also had above normal precipitation of similar magnitude. The eastern slopes of the Cascades/central WA had much below normal precipitation for April, however, with precipitation between 2 and 50% of normal in those locations (i.e, Wentachee, Omak, and Ephrata at 6, 21, and 53% of normal, respectively).

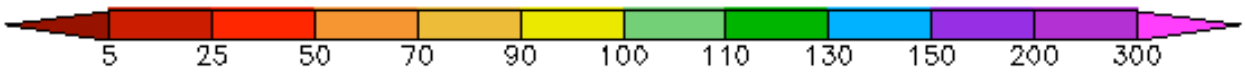


Temperature (°F)





Precipitation (%)



April temperature (°F) departure from normal (top) and April precipitation % of normal (bottom). Source: High Plains Regional Climate Center (http://www.hprcc.unl.edu).

	Mean Temperature (°F)			Precipitation (inches)			Snowfall (inches)		
	Avg	Norm	Departure from Normal	Total	Norm	% of Norm	Total	Norm	% of Norm
Western Washington									
Olympia	43.7	47.4	-3.7	4.11	3.58	115	0	0.1	0
Seattle	46.9	50.1	-3.2	3.36	2.84	118	0	M	M
Sea-Tac	45.5	50.2	-4.7	4.47	2.59	173	0	0.1	0
Quillayute	42.7	46.7	-4.0	7.84	7.44	105	0	0.3	0
Bellingham Airport	45.4	49.1	-3.7	4.64	2.75	169	M	0.2	M
Vancouver	47.9	51.3	-3.4	4.23	2.44	173	0	M	M
Eastern Washington									
Spokane AP	41.5	46.5	-5.0	1.81	1.28	141	1.1	1.7	65
Wenatchee	45.7	51.5	-5.8	0.03	0.47	6	M	T	M
Omak	43.5	49.6	-6.1	0.23	1.11	21	M	M	M
Pullman	40.9	46.2	-5.3	2.50	1.72	145	M	M	M
Ephrata	45.0	51.6	-6.6	0.23	0.43	53	M	M	M
Yakima	44.7	48.6	-3.9	0.32	0.53	60	0	0	0

Table 1 - April climate summaries for locations around Washington. The climate normal baseline is 1971-2000 except for Seattle WFO (1986-2000) and Vancouver (1998-2010). Please be aware that the Seattle WFO and Vancouver climate normal periods are shorter than the 30-year period that is typically used for climatology. M denotes a missing value.

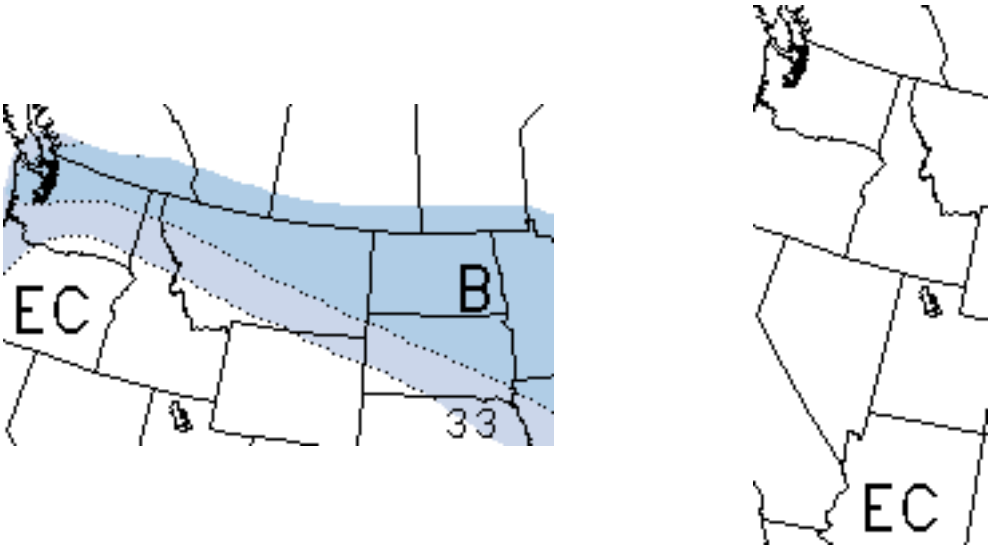
Climate Outlook

La Niña conditions are continuing to weaken across the equatorial Pacific Ocean. Weakly positive sea surface temperature anomalies have developed in the eastern Pacific, according to the CPC (http://www.cpc.noaa.gov/products/precip/CWlink/MJO/enso.shtml), Climate Prediction Center. The La Niña is expected to continue to weaken with models indicating near-neutral ENSO conditions by summer.

The May-June-July (MJJ) outlook calls for chances of colder than normal temperatures for most of the state. The chances of cooler than normal temperatures are slightly higher across the northern portion of WA, with chances exceeding 40% using the three-class system. For the rest of the state, there is at least a 33% chance of cooler than normal temperatures. There are equal chances of below, equal to, or above normal precipitation for MJJ.

The summer (June-July-August) CPC three-class outlook has equal chances of below, equal to, or above normal temperatures and precipitation.

As a refresher on how to interpret the CPC seasonal outlooks, please consult Figure 9, which illustrates the breakdown of the temperature probabilities for the May-June-July Seattle forecast. The CPC seasonal forecasts have 3 categories, separating the chances of below, equal to, or above normal temperatures or precipitation into equal probabilities of 33%. When there is no skill in the seasonal forecast, the probabilities stay at 33% each. When there is at least a 33% chance of below normal temperatures, for example (Fig. 9), it should be looked at as a slight tilting of the odds in favor of lower than normal temperatures. In this example, there is a 38% chance of lower than normal temperatures for MJJ. The near normal probability stays at 33%, but the probability of above normal temperatures decreases to 29%, thus tilting the odds towards a higher probability of cooler temperatures.



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

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

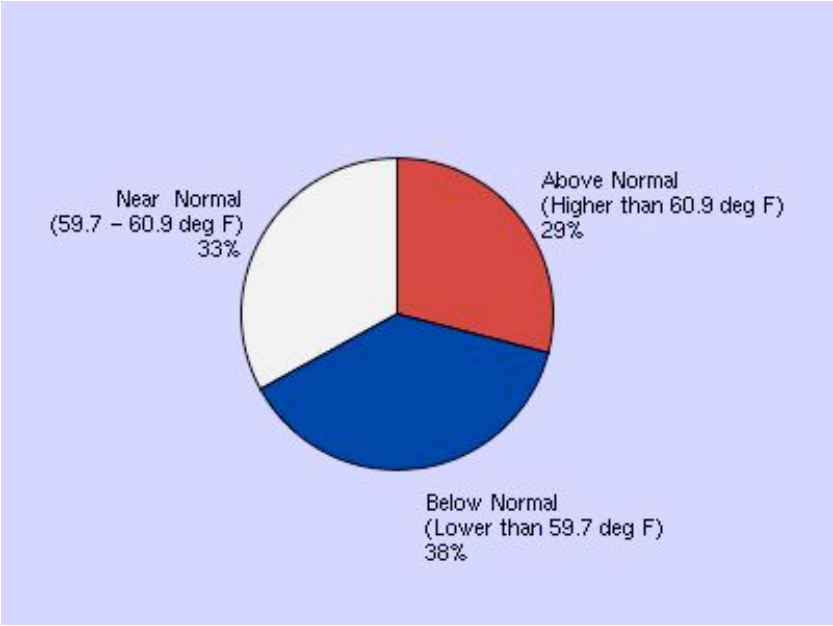


Figure 9: A pie chart illustrating the three-class CPC outlook for May-June-July for Seattle (from the National Weather Service).