Office of the Washington State Climatologist

February 5, 2016

January Event Summary

Mean January temperatures were near-normal to above normal for the entire state, and precipitation was generally above normal with some exceptions. In particular, the Cascade Mountains and parts of the northern Puget Sound area received less than usual for the month (see "Climate Summary" section for more information).

In this Issue

A strong temperature inversion was the dominant weather pattern for the first several days of January, with some areas of fog in the morning before clearing for sunny and cold days. On the 3rd, the low temperature in Pasco got down to 8°F, tying for the record low minimum temperature for the calendar day. In general, the first ten days of the month were on the dry side, but wet conditions prevailed for the remainder of the month bringing most monthly precipitation totals to above normal. There were a few instances of freezing rain and light snow in parts of eastern WA in the beginning of the month, as an exception to this generalization. And scattered light snow was measured in western WA on the morning of the 4th, especially at higher elevations. Figure 1 shows daily precipitation (dark green bars) for Spokane Airport compared to normal (light green) and records (light red).

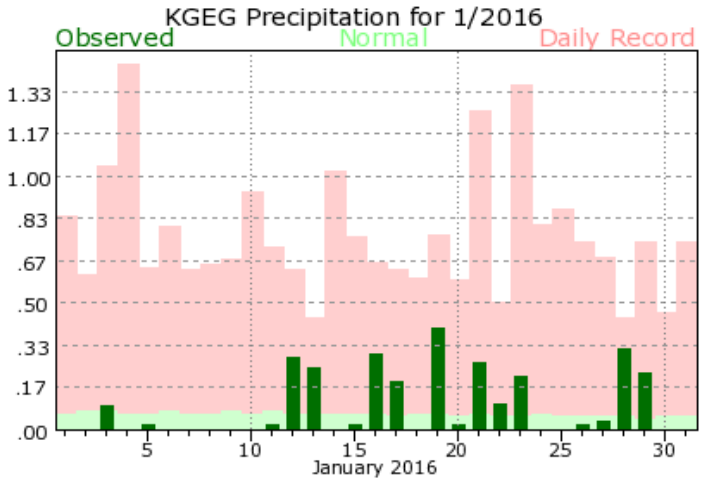


Figure 1: January 2016 daily precipitation (dark green bars) in inches for Spokane Airport. The shading represents the normal precipitation (light green) and the daily maximum precipitation (red) in the historical record (from the National Weather Service).

The first of several storms bringing heavy rain approached WA State on the 11th with rain in western WA and snow in eastern WA. On the 12th, Quillayute measured a record rainfall amount for the date of 2.36". The wet period that followed also brought snow to the mountains, particularly on the 15th. Precipitation continued through the week as a series of

systems moved across the state. The 19th brought heavy rain to western WA and snow to eastern WA with Wenatchee Airport (0.43") and Yakima (0.50") setting maximum precipitation records on the day. Even heavier precipitation fell on the 21st, however, with minor flooding in western WA. Maximum daily rainfall records were set at Hoquiam (3.98"), Quillayute (2.50"), Olympia (1.75"), and the Seattle Weather Forecasting Office (1.66") on the 21st. Freezing levels were high with this event, and most of the precipitation fell as rain around the state. The month ended with more rainy days than dry ones.

Snowpack and Drought Update

Despite the Cascade Mountains receiving slightly below normal precipitation for the month of January, snowpack across the state is still normal to above-normal. Additionally, the mountains of eastern WA benefited from a southeasterly anomaly in the flow over the last month. Figure 2 shows the snow water equivalent (SWE) percent of normal averaged for each basin in WA as of February 1 from the National Resources Conservation Service. The Upper Columbia has the most snowpack in a relative sense, with 134% of normal. The Central Columbia and Lower Yakima basins are also doing well with 118 and 122% of normal, respectively. The remaining basins have near-normal SWE with values ranging between 91 and 106% of normal. The US Drought Monitor has continued to show improvements in WA State drought since the last newsletter (Figure 3). Only one area of the state - southeastern WA - remains in drought conditions, with a designation of "moderate drought". The larger area of eastern WA in the D0 category is an indicator of long-term precipitation deficits as short-term conditions have improved.

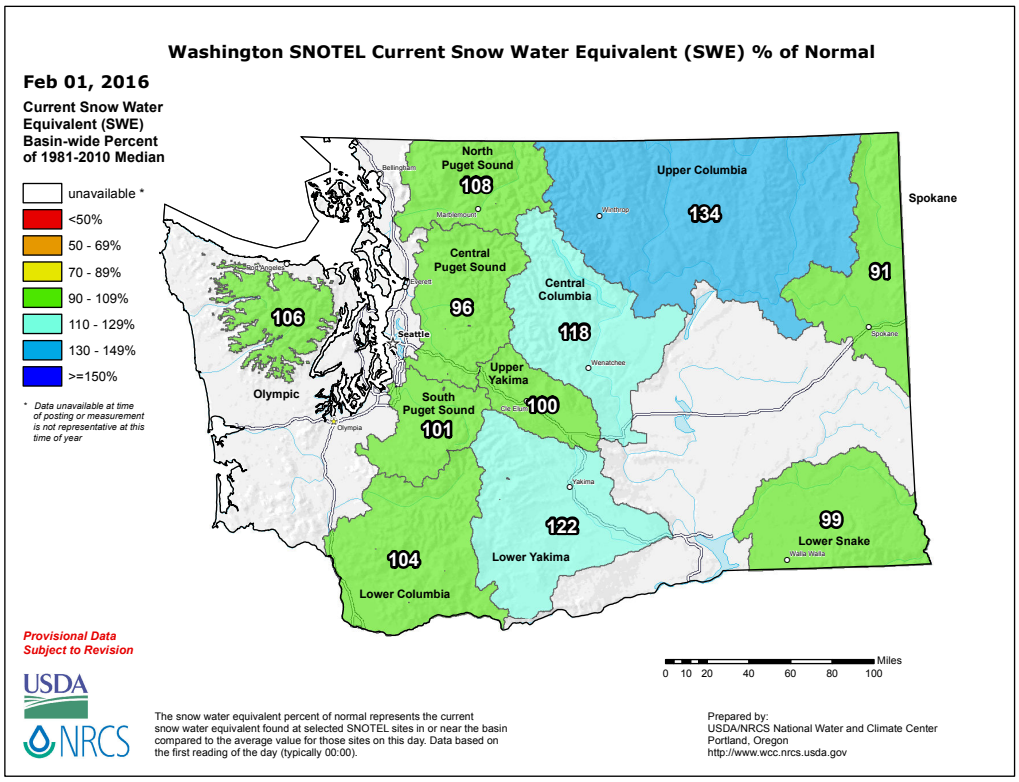


Figure 2: Snowpack (in terms of snow water equivalent) percent of normal for Washington as of February 1, 2015 (from the National Resources Conservation Service).

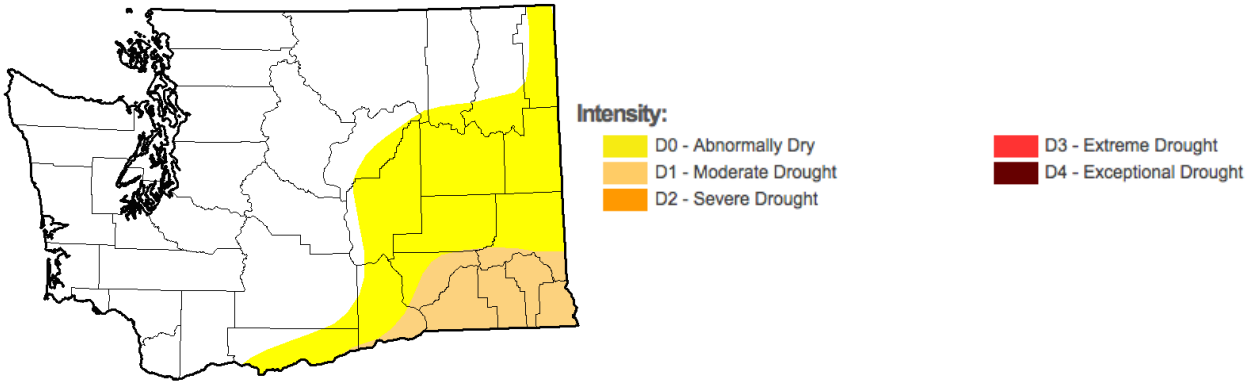


Figure 3: The February 2, 2016 edition of the US Drought Monitor (http://droughtmonitor.unl.edu/).

Experimental 3-4 Week Forecasts from NOAA/CPC

A message from the State Climatologist

There are two basic types of meteorological forecasts. On shorter time scales, present atmospheric conditions can be used to predict spatial and temporal details in the evolution of the atmospheric flow and associated weather. Current generation numerical weather prediction (NWP) models typically demonstrate considerable skill out 3-7 days (e.g., Bauer et al. 2015), with large improvements in skill made over the past 4 decades (Figure 4). On longer time scales, months to about a year, forecasts key on mean patterns accompanying slowly varying boundary conditions for the atmosphere, such as sea surface temperature and soil moisture. Characterization of the temporal variability in the circulation and weather is not feasible beyond the period when initial atmospheric conditions play a dominant role. That leaves a gap between short-term weather forecasts and longer-term seasonal projections.

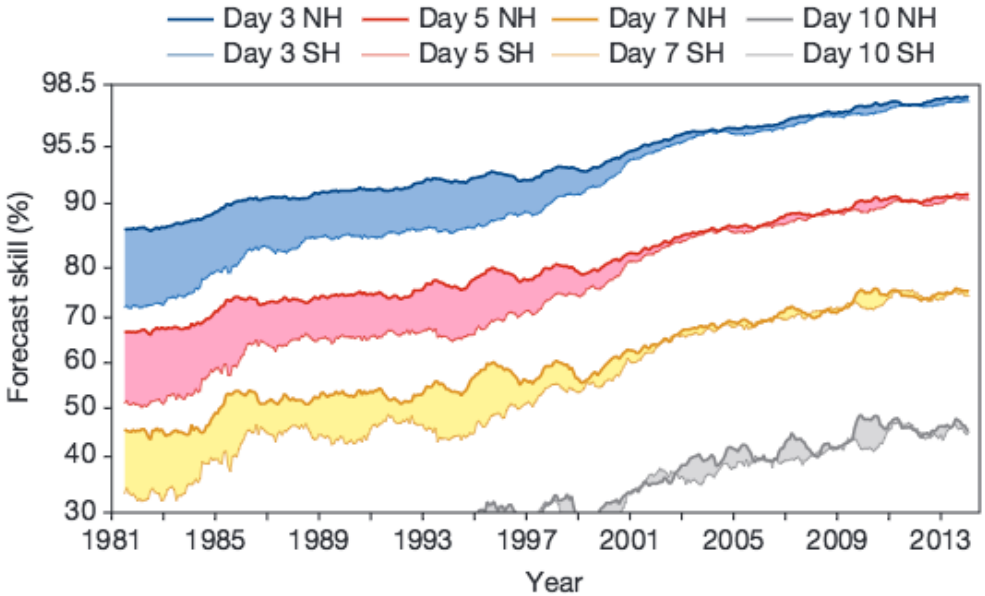
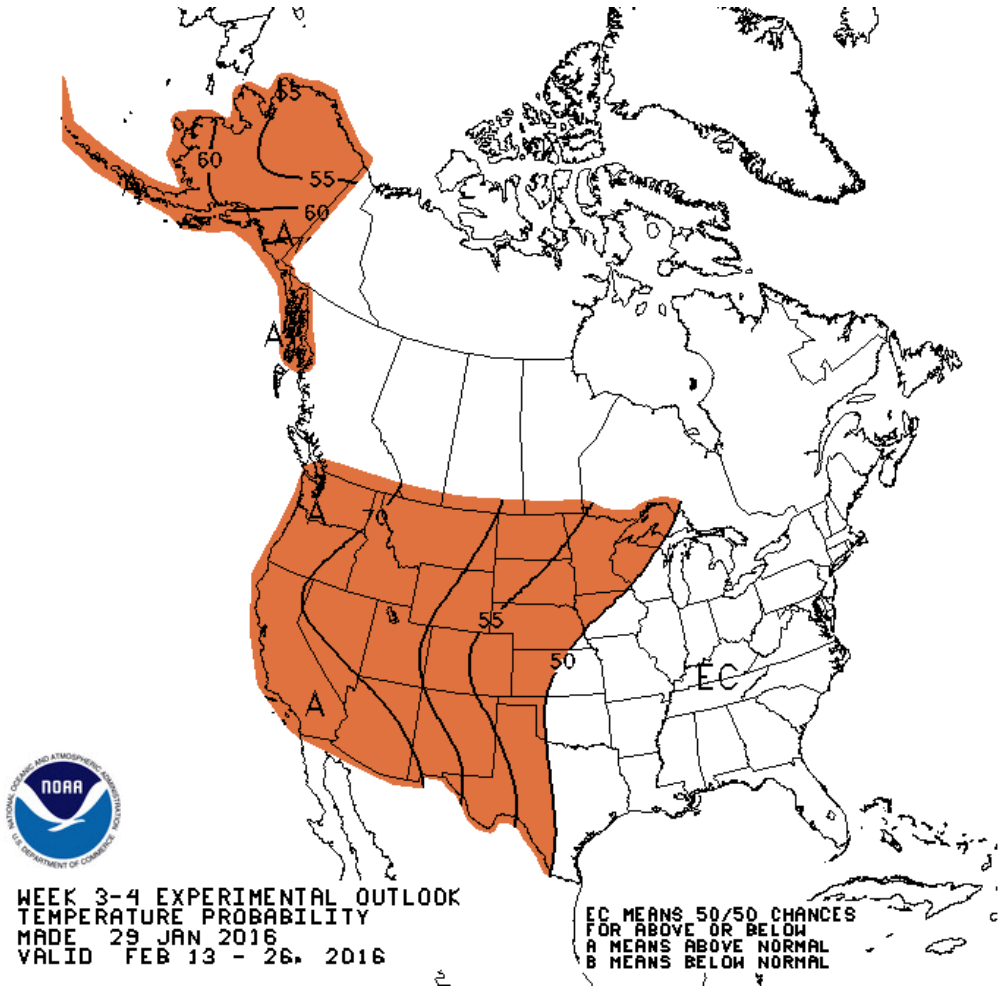


Figure 4: Skill (%) in 3-, 5-, 7-, and 10-day ECMWF operational model forecasts of 500 hPa geopotential height distributions for the northern (NH) and southern (SH) hemispheres from 1981 to 2014. Improved assimilation of satellite data is responsible for the relative increase of skill for the SH shown on the graph after 1999 (from Bauer et al. 2015).

A new product from NOAA's Climate Prediction Center (CPC) attempts to bridge that gap. Experimental forecasts of temperature and precipitation for the U.S. for week 3-4 are now being provided by CPC. These forecasts are updated once a week on Friday afternoon and are posted on the following website: http://www.cpc.ncep.noaa.gov/products/predictions/WK34/. A recent example is shown here (Figure 5). The information consists of the expected distributions of the anomalous temperature and precipitation for the 3 to 4 week period as a whole in the three-tier format used for the seasonal forecasts. A forecast discussion is included. As indicated in these discussions, the basis for the forecasts includes output from ensembles of extended NWP model simulations from the European Centre for Medium-Range Weather Forecasting (ECMWF), the Japan Meteorological Agency (JMA) and NOAA's Center for Environmental Prediction (NCEP). Consideration is also given to the present state of slowly varying components of the atmosphere-ocean-land system, with El Niño representing an important contribution currently. In addition, these forecasts exploit the Madden-Julian Oscillation (MJO), which represents a major source of variability in the tropics on 40-60 day time scales. The MJO often has some predictability out a few weeks; the phase of the MJO exhibits teleconnections with the weather at higher latitudes, including the Pacific Northwest (Bond and Vecchi 2003).



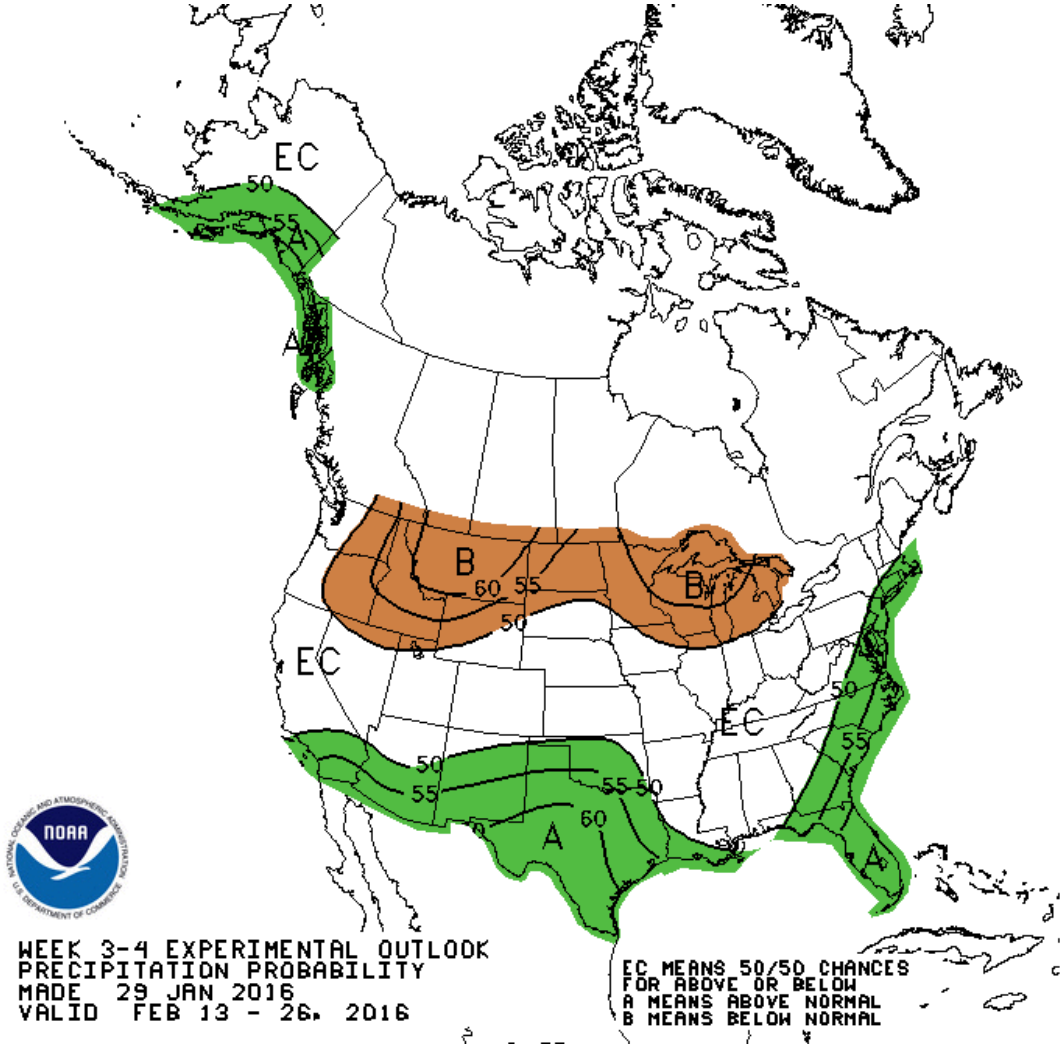


Figure 5: The 3-4 week experimental outlook for temperature (top - previous page) and precipitation (bottom) made on January 29, 2016 and valid for February 13-26 from the Climate Prediction Center.

It remains to be seen how much useful skill these 3-4 week forecasts will have in a real-time setting. The truest test of forecasts is in true predictive mode without the benefit of hindsight, which is what is being done with this product release. Moreover, the lessons learned from carrying out these forecasts should help show which factors are most important in different situations, and ultimately how these kinds of predictions can be improved. We are interested in the weather on this time scale, of course, and are curious about just how well it can be anticipated.

References

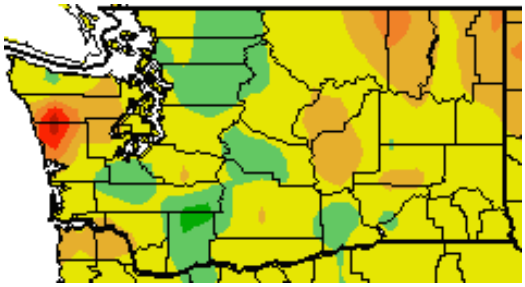
Bauer, P., A. Thorpe, and G. Brunet (2015): The quiet revolution of numerical weather prediction, *Nature*, **525**, *47-55*.

Bond, N.A. and G.A. Vecchi (2003): The influence of the Madden-Julian Oscillation on precipitation in Oregon and Washington. *Wea. Forecast*, **18**, 600-613.

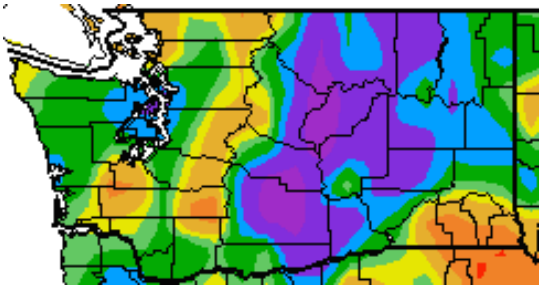
Climate Summary

Mean January temperatures were on the warmer side of normal for nearly the entire state, but the monthly anomalies are not as warm as has been seen in several recent months. As shown on the map from the High Plains Regional Climate Center below, temperatures were within 2°F of normal for most of the state. It should be noted that the warm bull's eye on the Olympic Peninsula is caused by 1 station reading and is likely an error; it will be confirmed over the coming months. There were a few warmer locations, but not to the extent of that anomaly. Namely, Ephrata and Quillayute, were 2.9 and 2.4°F above normal, respectively (Table 1). Vancouver was near-normal with an anomaly of -0.2°F.

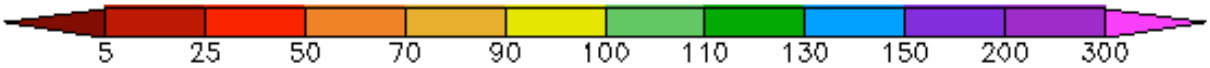
Total January precipitation was above normal for nearly the entire state, particularly in eastern WA. Precipitation in most of eastern WA was between 130 and 299% of normal, according to the map below. Wenatchee, for example, received 209% of normal and Ephrata received 180% of normal (Table 1). Much of western WA also received above normal precipitation for January, though the anomalies weren't as great, with totals ranging between 110 and 150% of normal. In terms of actual rainfall, western WA still received more than eastern WA, of course. The west slopes of the Cascades and portions of western WA were on the dry side, but mostly to a modest extent (~70-90% of normal). Bellingham was one of the dry spots with 67% of its normal precipitation for the month (Table 1).



Temperature (°F)



Precipitation (%)



January 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)			Snowfall (inches)		
	Avg	Norm	Departure from Normal	Total	Norm	% of Norm	Total	Norm	% of Norm
Western Washington									
Olympia	40.4	39.8	0.6	8.47	7.84	108	0	1.9	0
Seattle WFO	43.5	42.1	1.4	7.19	4.81	149	T	0.4	0
SeaTac AP	43.7	42.0	1.7	7.45	5.57	134	T	1.4	0
Quillayute	44.0	41.6	2.4	15.72	14.61	108	0	2.0	0
Hoquiam	44.0	42.6	1.4	14.30	10.33	138	0	1.3	0
Bellingham AP	41.2	39.2	2.0	3.11	4.67	67	0	3.4	0
Vancouver AP	41.4	41.6	-0.2	7.10	5.50	129	0	M	-
Eastern Washington									
Spokane AP	31.0	29.5	1.5	2.74	1.79	153	6.7	11.4	59
Wenatchee	31.7	29.5	2.2	2.22	1.06	209	M	1.06	-
Omak	28.4	26.8	1.6	2.28	1.89	121	M	M	-
Pullman AP	33.5	31.6	1.9	2.62	1.82	144	M	M	-
Ephrata	31.7	28.8	2.9	1.64	0.91	180	M	M	-
Pasco AP	35.1	34.9	0.2	1.19	1.22	98	T	0.6	0
Hanford	34.7	33.4	1.3	1.47	0.94	156	3.5	4.6	76

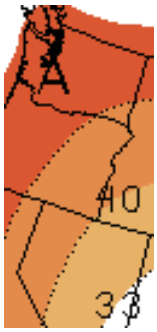
Table 1: January 2016 climate summaries for locations around Washington with a climate normal baseline of 1981-2010. Note that the Vancouver Pearson Airport and Seattle WFO 1981-2010 normals involved using surrounding stations in NCDC's new normal release, as records for these station began in 1998 and 1986, respectively. "M" denotes missing data.

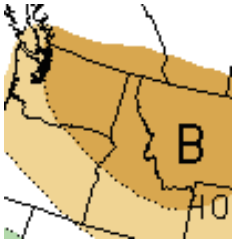
Climate Outlook

El Niño conditions in the tropical Pacific Ocean are still present, according to the Climate Prediction Center (CPC). Weekly sea surface temperature (SST) anomalies have decreased over the last month, particularly in the eastern equatorial Pacific, but are still much warmer than normal. The SST anomalies exceed 2°C in the central tropical Pacific Ocean (Niño 3.4 and Niño 3 regions), and the event can still be categorized as a strong El Niño. The "El Niño Advisory" released by the CPC on 5 March 2015 is still in effect, and the ENSO forecast models show the El Niño will gradually decrease through the spring. By the 3-month period of April through June, the chances of El Niño persisting decreases to just over 60%. The chance of El Niño winding down increases with time, with neutral ENSO conditions expected by summer.

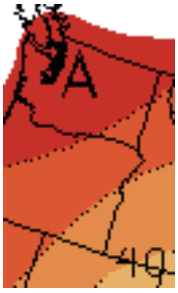
The CPC seasonal outlook for February is calling for increased chances of above normal temperatures statewide. The chances of warmer than normal temperatures exceed 50% on the three-tiered system (each outcome - below, equal to, or above normal - has a 33.3% chance of occurring until the odds are tilted). With regards to precipitation, there are higher chances of below normal precipitation for February.

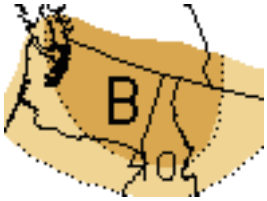
The February-March-April (FMA) CPC outlook is similar to the February outlook: there are higher chances of above normal temperatures and below normal precipitation for the period. The odds of a warmer than normal February through April is higher than the February outlook, with greater than a 60% chance.





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





February-March-April outlook for temperature (left) and precipitation (right) from the CPC.