Office of the Washington State Climatologist

March 10, 2014

February Event Summary

Mean February temperatures were colder than normal statewide, and total February precipitation was above normal for most of the state. In light of the several dry months that WA has endured recently, the above normal precipitation was very much welcomed. More on the status of drought concerns is summarized in the "Snowpack" section of this newsletter.

In this Issue

The month began with some light, scattered rain and snow showers around the state, but the most interesting feature in the beginning of the month was the cold spell that lasted through February 9th. Cold, Canadian air impacted the regions of the northern Puget Sound and eastern WA especially, and many record daily temperature records were set. For example, on February 5th, cold high temperature daily records were set at La Crosse (18°F), Wenatchee (16°F), and Republic (11°F) and cold low temperature daily records were set at Grand Coulee (1°F) and Boundary Dam (-15°F). The cold temperatures and windy conditions resulted in wind chills below 0°F throughout much of eastern WA during this period. Snow also fell during this cold spell, including between about 2 and 8" in Clark County on the 6th. More snow later in the period fell throughout the state including the western WA lowlands, and set some daily maximum snowfall records on February 8th at SeaTac (2.9"), Olympia (3.2"), and Yakima (9.7").

The air mass changed on the 10th, ushering in warmer temperatures and a parade of storms that brought rain to the lowlands, snow in the mountains, and mixed precipitation east of the Cascades through the remainder of the month. Minor flooding, heavy rain and snow, and avalanche warnings ensued - more typical Northwest winter conditions compared to earlier in the season. A few weather highlights during this period are summarized in the following paragraph.

The wet Presidents Day weekend was also rather windy around the state with gusts between 30 and 50 mph in eastern WA on the 13th and gusts between 20 and 40 mph in western WA on the 14th. Stronger winds accompanied by another frontal passage late on February 15th brought gusts of 56 mph in Bellingham, 54 mph in Hoquiam, 52 mph at SeaTac Airport, and 47 mph on Whidbey Island, for example. Record daily maximum rainfall totals were set at Hoquiam (1.82") on the 16th and at Olympia Airport (1.23") on the 17th. Finally, the last

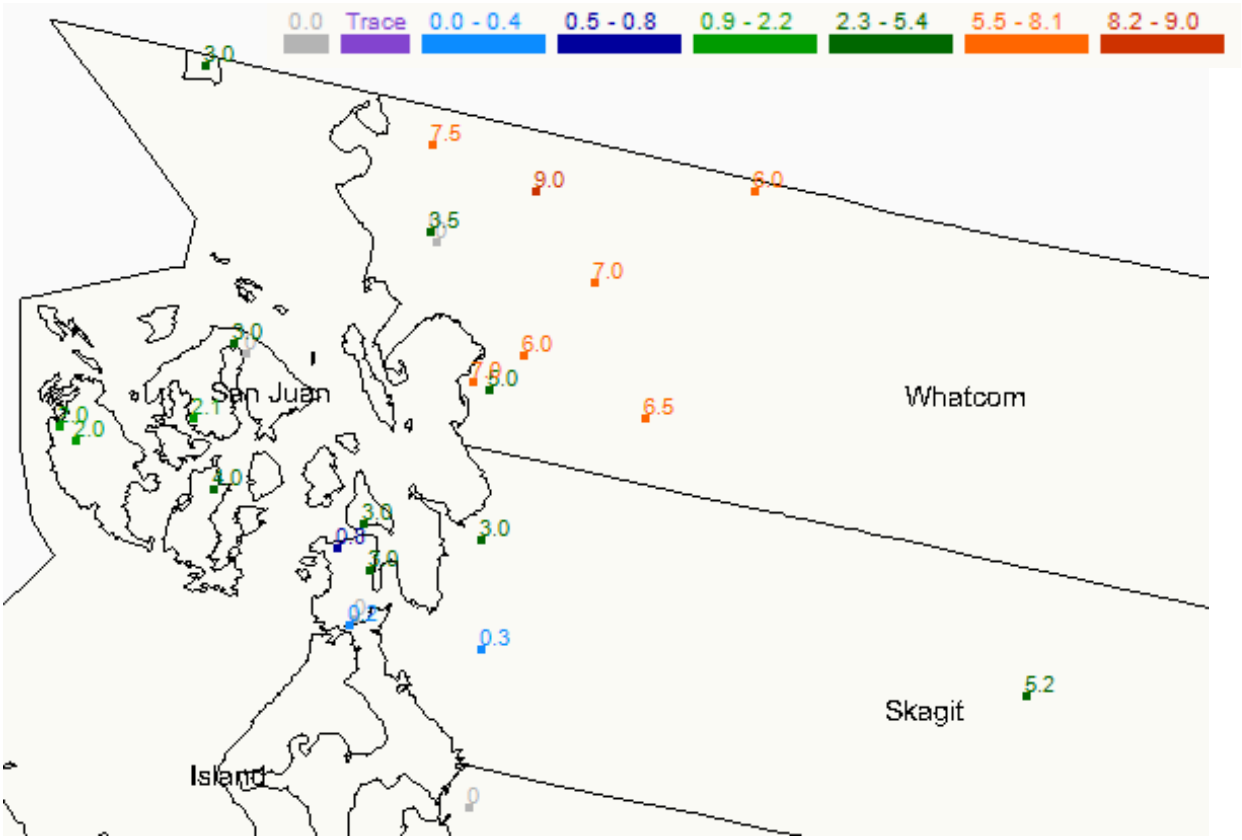


Figure 1: 24-hr snowfall measurements in the northern Puget Sound ending on the morning of February 24, 2014 between 7 and 9 am from volunteer CoCoRaHS observers.

weekend in February (22-24) was rather snowy in Whatcom, Skagit, and San Juan Counties where up to a foot of snow was measured (but 6" was more common). Figure 1 shows the 24-hour snowfall totals on the morning of February 24th from CoCoRaHS observers.

CoCoRaHS

Thank you, Community Collaborative Rain, Hail, and Snow (CoCoRaHS) network observers, for taking frequent measurements during the last, wet month. As many of you might be aware, there is a nationwide contest officially taking place - dubbed "CoCoRaHS March Madness" - to see which state can recruit the most new volunteers during March. Please spread the word about CoCoRaHS to your friends and family. New participants can learn more and register at www.cocorahs.org. As you can see from the map featured above, these measurements are extremely valuable to OWSC, especially for snowfall. As an aside, the CoCoRaHS station located at OWSC on UW campus received 6.41" of precipitation for February - more than measured at both SeaTac Airport (6.11") and the Seattle National Weather Service office at Sandpoint (5.13").

Snowpack Summary

The growth in the snowpack over the last month has been remarkable, as shown in Figure 2 - the snow water equivalent (SWE) percent of normal as of March 3 from the National Resources Conservation Service (NRCS). The North Puget Sound, Central Puget Sound, South Puget Sound, Central Columbia, Upper Yakima, Lower Yakima, and the Spokane basins all have average SWE that is near-normal, ranging between 92 and 105% of normal. The Lower Snake basin is even above normal, with 114% of normal SWE. The Upper Columbia, Lower Columbia, and Olympic basins are still lagging behind normal, with average basin SWE between 81 and 85% of normal. Still, the growth in snowpack is quite impressive. The snow depth on Hurricane Ridge in the Olympic Mountains, for example, doubled from Feb 1 (32") to Mar 1 (64"). Despite this growth in snowpack, there still remains some concern for parts of eastern WA that did not receive a lot of the heavy precipitation seen during February. The latest US Drought Monitor (Figure 3) has these areas in the "severe drought" category, based on a combination of the much lower than normal precipitation percent of normal numbers for the water year, extremely dry soils, and the below normal snowpack in the Upper Columbia. The Drought Monitor has scaled back the dryness designation for the remainder of the state in light of the recent precipitation.

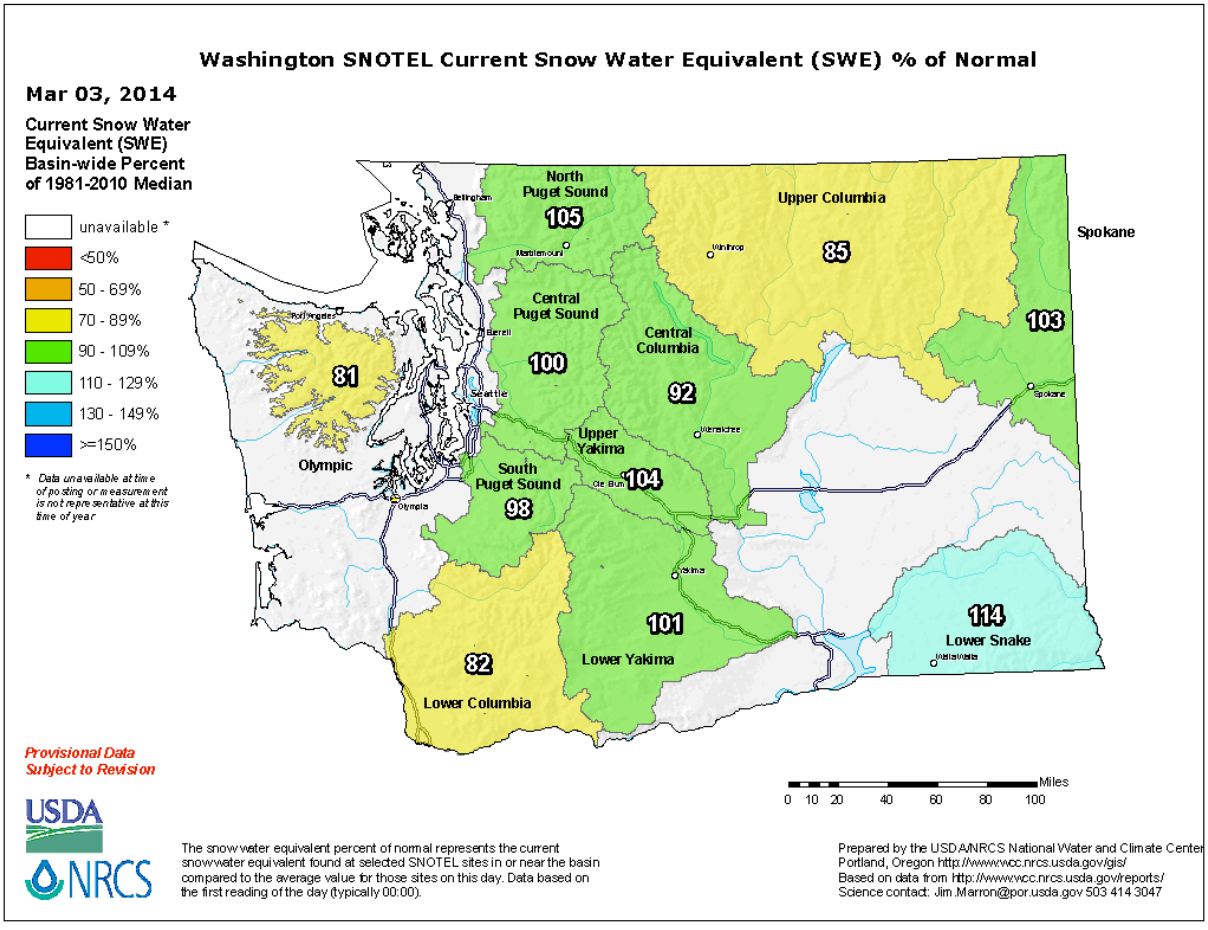


Figure 2: Snowpack (in terms of snow water equivalent) percent of normal for Washington as of March 3, 2014. Image is from the National Resources Conservation Service (NRCS).

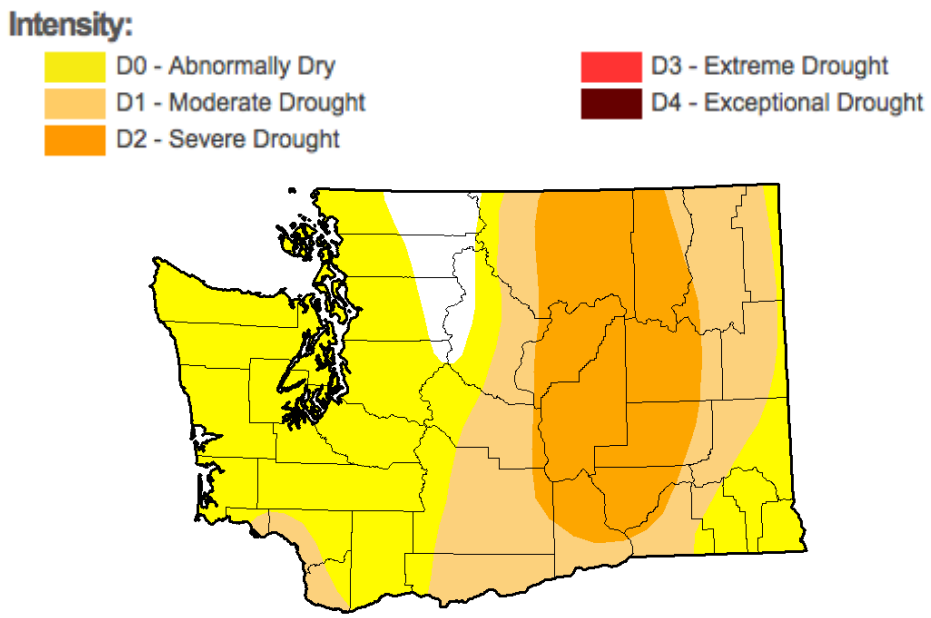


Figure 3: The March 4, 2014 edition of the US Drought Monitor (from the National Drought Mitigation Center).

The Quality of CFS Seasonal Winter Predictions for the Pacific Northwest

A message from the State Climatologist

Seasonal weather predictions are based increasingly on global climate model output. They have been evaluated for the tropical Pacific and other very large (continental scale) regions, but less is known about the quality of these predictions for specific regions such as the Pacific Northwest. This is a timely issue from a local perspective. The fall and early winter of 2013-14 was remarkably dry in Washington state; can these sorts of climate events be predicted with any reliability?

We might be in luck, at least relative to many other parts of the globe. As many readers of this newsletter are probably already aware, there are systematic effects on our weather associated with the El Niño-Southern Oscillation (ENSO), and the present suite of global climate models used for seasonal weather forecasting have meaningful skill at ENSO prediction out 6-9 months. But what does this imply in concrete terms about the forecasts for our region? Some recent research undertaken under the auspices of the coastal ocean prediction system called J-SCOPE (highlighted in the Sept 2013 newsletter) is relevant to this question. We hasten to emphasize that this is just a quick look at some aspects of the skill of seasonal forecasts from a regional ocean forcing perspective, and is therefore more illustrative, rather than anything close to a comprehensive analysis.

The analysis was based on re-forecasts from the Coupled Forecast System (CFSv2) model (Saha et al. 2006) from NOAA's National Center for Environmental Prediction (NCEP). The re-forecasts are simulations from a global atmosphere-ocean model that includes only the data

available at the time of initialization, and hence mimic the information available and procedure of the operational forecast model runs of the CFSv2. The re-forecasts for the period of 1982-2011 are considered here. Two sets of 6-month forecasts were examined for J-SCOPE: model predictions made in January for the following July as a whole, and predictions made in July for the following January. The analysis was restricted to selected parameters important to the forcing of the coastal marine ecosystem. Here we show results of CFSv2 model predictions made in July for the following January for two parameters: the north-south component of the surface winds over the coastal waters averaged over a box extending from 43-49°N and 128-124°W, and 925 hPa air temperatures in the coastal region of 43-49°N and 125-121°W.

The 6-month forecasts of the winds (Fig. 4) are superior to those of 925 hPa (atmospheric boundary layer) air temperature (Fig. 5) in the overall sense. The correlation between the forecasts and observed conditions are 0.39 and 0.21 for the winds and temperatures, respectively. The majority of the forecasts are good and some are excellent, but there are a few real clinkers. There is some indication of an improvement with time, presumably to the availability of more or different observations for model initialization, since the same model is used for the entire period. But there was also a recent bust. The winter of 2008-09 included a weak-moderate La Niña, and while the model correctly predicted the suppressed southerly winds, as is usually the case during La Niña, it also forecast a colder than normal temperature in January 2009, during which it was actually relatively warm (it was cold and snowy in December 2008). It turns out that CFSv2 model skill is higher for PNW forecasts made in summer for the following winter than those made in winter for the following summer. In other words, perhaps we can better anticipate the winter weather for skiers than coastal marine habitat in summer for juvenile salmon.

A similar type of analysis has not been carried out for precipitation, and so here we cannot say much about the aforementioned dry stretch during October 2013-January 2014. Review of past model forecasts from the CFSv2 during early fall 2013 for precipitation were a mixed bag. Some of the forecasts, but by no means all, indicated that it would be relatively dry over the period, but generally not to the extent that was observed. More consistency was provided by the National Multi-Model Ensemble (NMME) and the International Multi-Model Ensemble (IMME). The forecasts made by NMME and IMME last fall for early and middle of past winter indicated the right sense of the precipitation anomalies if not the extreme magnitude. As in short-term weather forecasts, a multi-model approach is generally preferable, and the recent predictions for our seasonal weather are no exception. It is worth mentioning that global climate models cannot be expected to replicate small scale (mesoscale) variations in precipitation since their coarse resolution prevents proper account of the effects of regional terrain.

Reference: Saha, S., and Coauthors, 2006: The NCEP Climate Forecast System. J. Climate, 19, 3483-3517.

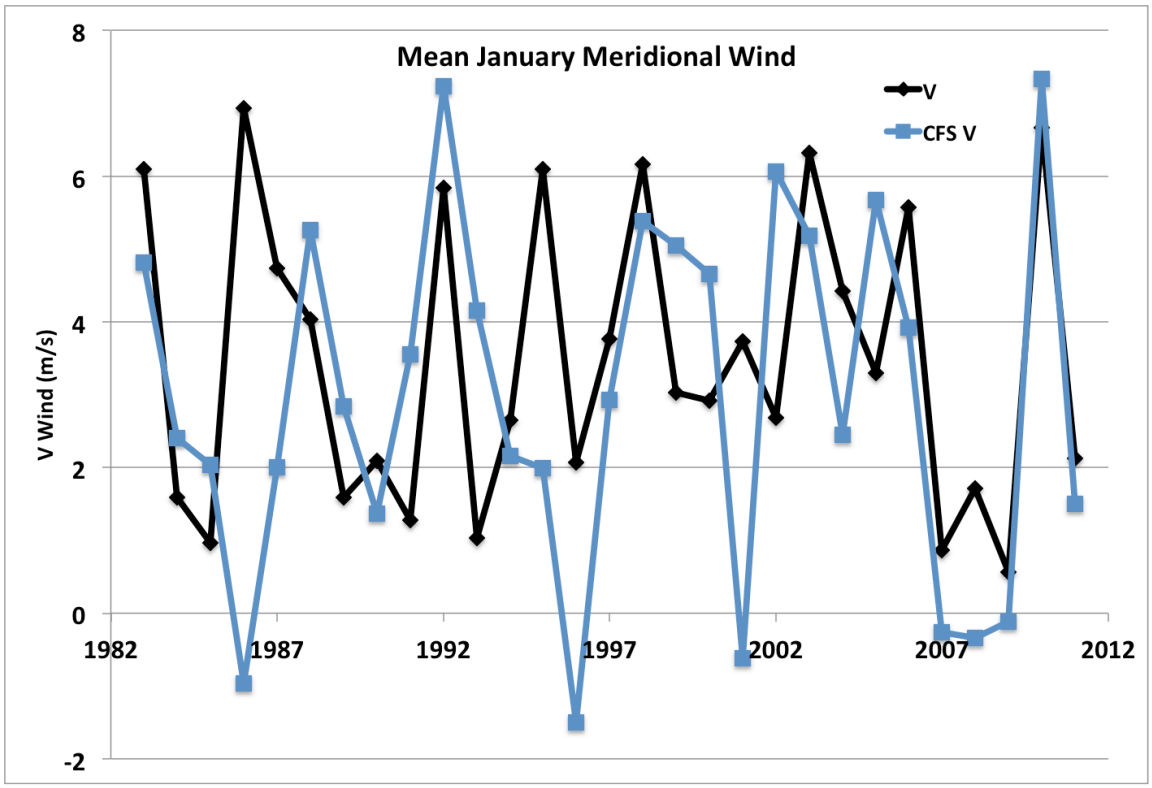


Figure 4: The CFSv2 model predictions for January made 6 months prior for the north-south component of the winds off the WA coast (blue) and the actual winds (black).

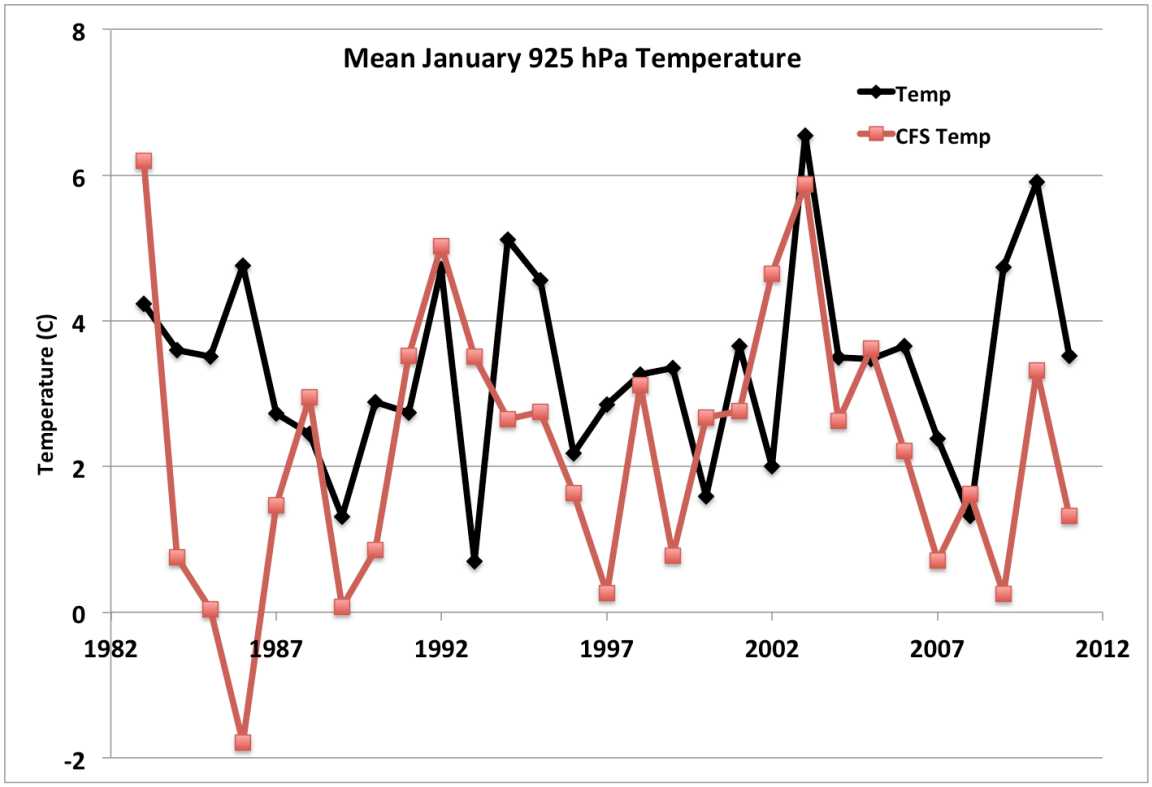
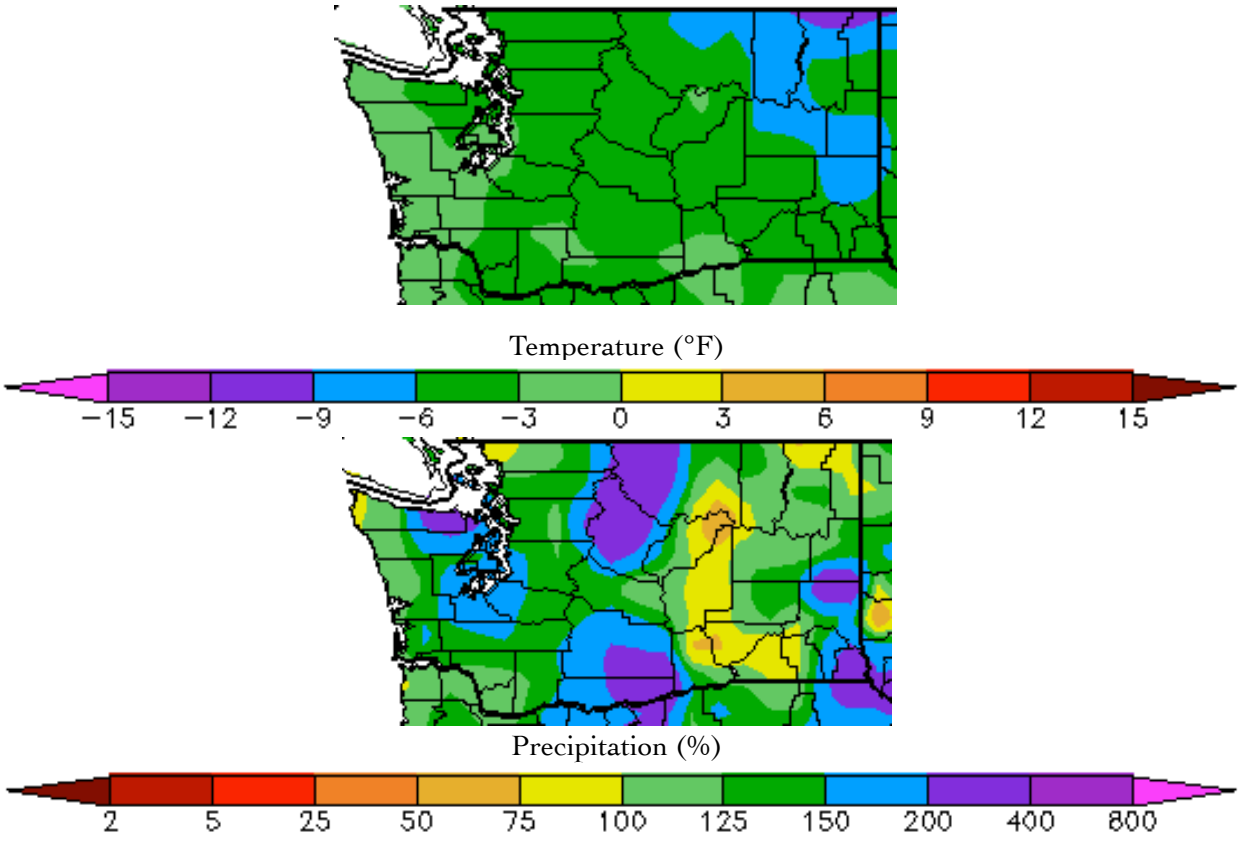


Figure 5: The CFSv2 model predictions for January made 6 months prior for the atmospheric boundary layer air temperature for the coastal region of WA and OR (red) and the actual temperature (black).

Climate Summary

Mean February temperatures were much below normal for a majority of WA State, as shown in the map from the High Plains Regional Climate Center below. Most of the state had temperatures between 3 and 6°F below normal, and some locations in northeastern WA were even colder. Spokane Airport was one such station, with average February temperatures 7°F below normal (Table 1). The Olympic Peninsula into the southern and central Puget Sound was a little warmer, and had temperatures that were near-normal (e.g., Quillayute) to 3°F below normal (e.g., Bellingham, Hoquiam, Seattle).

Total February precipitation finally broke the 4-month streak of below normal precipitation; statewide, precipitation was near to above normal. Parts of the Puget Sound, and much of the Cascades received between 150 and 400% of normal precipitation for the month. A large portion of western WA received between 125 and 150% of normal. The Columbia basin was the exception, only receiving between 75 and 100% of normal precipitation. Pasco, Ephrata, and Wenatchee, for example, received 72, 89, and 94% of normal precipitation (Table 1). Regarding the snowfall, the cold and wet month allowed for more snow than typical to fall during the month. Spokane, for example, received nearly 18" of snow, and almost 3" fell at SeaTac Airport (Table 1).



February temperature (°F) departure from normal (top) and February precipitation % of normal (bottom).
(High Plains Regional Climate Center (http://www.hprcc.unl.edu); 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	38.3	41.0	-2.7	8.35	5.27	158	3.2	4.7	68
Seattle WFO	40.7	43.4	-2.7	5.13	3.31	155	2.0	0.6	333
SeaTac AP	41.7	43.4	-1.7	6.11	3.50	175	2.9	1.7	171
Quillayute	42.0	42.1	-0.1	10.64	10.35	103	0	2.6	0
Hoquiam	41.1	43.7	-2.6	8.02	7.21	111	T	0.8	0
Bellingham AP	37.6	40.8	-3.2	2.67	3.02	88	M	2.4	-
Vancouver AP	39.3	43.5	-4.2	4.35	4.03	108	M	M	-
Eastern Washington									
Spokane AP	26.0	33.0	-7.0	1.81	1.33	136	17.9	6.8	263
Wenatchee	29.5	34.8	-5.3	0.76	0.81	94	M	4.4	-
Omak	27.8	31.8	-4.0	1.50	1.30	115	M	M	-
Pullman AP	28.6	34.9	-6.3	2.53	1.52	166	M	M	-
Ephrata	30.1	34.1	-4.0	0.66	0.74	89	M	3.1	-
Pasco AP	35.5	38.9	-3.4	0.62	0.86	72	M	M	-
Hanford	33.9	38.2	-4.3	1.12	0.70	160	11.9	2.3	517

Table 1: February 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.

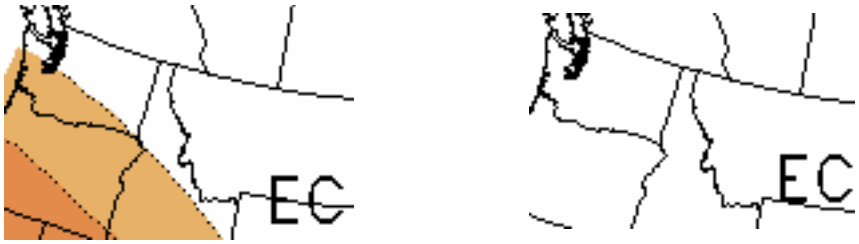
Climate Outlook

The conditions in the equatorial Pacific Ocean are ENSO-neutral, according to the Climate Prediction Center (CPC): http://www.cpc.ncep.noaa.gov/. Averaged over the last 4 weeks, sea-surface temperatures (SSTs) remain above normal in the western equatorial Pacific Ocean and are below normal in the central and eastern equatorial Pacific Ocean. There is a consensus among the model predictions that near-neutral ENSO conditions will persist through the spring 2014. As for conditions beyond that, the CPC recently released an "El Niño Watch" on March 6 for an increased likelihood of El Niño development in the summer or fall.

The seasonal outlooks provided by the Climate Prediction Center do not give much indication of the sense of the climate anomalies for the month of March. The CPC three-class outlook for March has equal chances of below, equal to, or above normal temperatures and precipitation for the entire state.

The three-month spring (March-April-May; MAM) temperature outlook has a slightly higher chance of above normal temperatures for the southern half of WA State, but the remainder of the state has equal chances of below, equal to, or above normal temperatures. The precipitation outlook for early spring is also calling for equal chances ("EC") of below, equal to, or above normal precipitation statewide.

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



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