Office of the Washington State Climatologist

December 3, 2013

November Event Summary

In this Issue

Mean November temperatures were near to below normal around the state, and precipitation was uniformly much below normal. While this past November did not set records, it did rank in the top ten driest Novembers for several stations around the state. Table 1 lists some examples, showing the precipitation amount for November 2013, the ranking, the record low precipitation and the year, as well as the year that measurements began at the station. These dry conditions in addition to the extremely dry October conditions means that we are behind for precipitation and snow totals in the mountains for the 2014 water year.

The first weekend of the month (Nov 2-3) was eventful weather-wise; there was mountain snow, gusty winds (e.g., 59 mph at SeaTac Airport; 66 mph at Whidbey Island Naval Air Station; 45 mph at Spokane), power outages, large ocean swells, and precipitation with some snow in eastern WA. That first weekend, however, did not portend how the rest of November would play out. There were only two other times during the month with stormy weather to note here: Nov 7 and Nov 18. There was heavy rain, mountain snow, and gusty coastal winds (between 45 and 59 mph) beginning on Nov 6 into Nov 7. Heavy rain fell statewide on Nov 18 into the 19th (Figure 1), even prompting a few flood warnings for western WA - the Skokomish River near Potlatch and Grays River near Rosburg. After this event, the weather pattern shifted to a blocking high pressure that resulted in dry and cold conditions. Low temperatures were in the teens and single digits in eastern WA on Nov 21, while lows dropped into the 20s and 30s for western WA. Goldendale recorded a record daily low temperature of 10°F on Nov 22. There were burn

Station	Nov 2013 Precipitation	Rank	Record Low Precip; Year	Records Began
Pasco	0.40”	5	0.17”; 2011	1945
Hoquiam	5.60”	7	2.51”; 1976	1953
Quillayute	7.92”	7	4.41”; 1976	1966
Centralia	2.54”	9	0.63”; 1936	1893

Table 1: November 2013 precipitation, the ranking (driest to wettest), the record driest and year of occurrence, and the year that records began at each station.

bans and air stagnation advisories during this period in the interest of preserving air quality. There were some mornings with heavy fog, but it was nowhere near as extensive as in October. This dry period had the unfortunate consequence of resulting in less-than-adequate mountain snow for skiing; most of the ski resorts in WA State were closed over the Thanksgiving holiday.

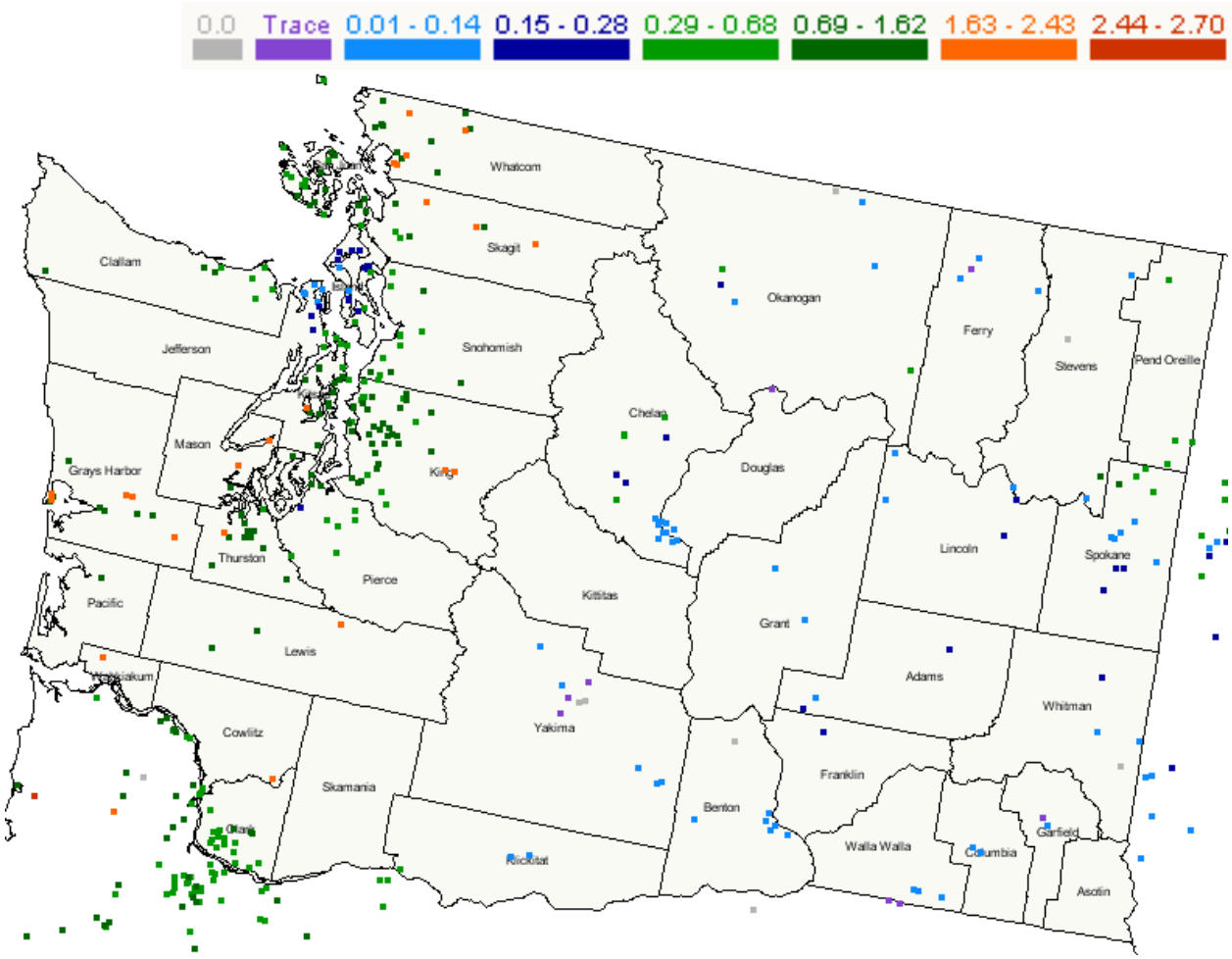


Figure 1: 24-hr precipitation totals from the Community, Collaborative, Rain, Hail, and Snow (CoCoRaHS) network on the morning of November 19, 2013 (between 7 and 9 am).

Causes and Examples of Landslides in WA

A message from the State Climatologist

Much of Washington state features steep terrain and unconsolidated soils, which means that landslides are a regular part of the landscape. And since many of these slides are associated with heavy rainfall, they occur more often in the winter, with plenty of exceptions. Of course they can also be triggered by a variety of other agents such as earthquakes, volcanic eruptions, water level changes, and human activities; here we focus on landslides associated with the weather. The purpose of this piece is to provide a brief discussion of their causes and relevant factors, summaries of some recent notable events, and some links for more information.

The landslides caused by intense rainfall tend to be shallow, fast-moving, and accompanied by debris, which makes them particularly hazardous. They often occur in locations where porous soils overlie more impermeable layers of clay or bedrock. The water that percolates down through this porous layer serves to float the sand and gravel particles above the interface with the lower layer. This reduces the binding between the layers, and if it gets low enough, the upper layer slumps under the force of gravity. It bears emphasizing that the threat of landslides is not related just to the steepness of the slope but also factors such as composition of the soil and landform characteristics such as bedrock hollows, many of which can be hidden. Our actions can increase (or decrease) the hazard. The removal of mature vegetation is an obvious example, but stability can also be compromised due to diversion of extra water onto a hillside, and by excavation, particularly at the toe of a slope.

Landslides or mudslides have been included in 10 of the Major Disaster Declarations by the federal government for WA since 1989. There are a few specific examples from the past couple of decades that are especially memorable. The holiday season of 1996-97 in the Puget Sound region is remembered for its one-two punch of snow followed by heavy rain. This caused a host of problems including the collapse of roofs and marinas, flooding, and slides resulting in millions of dollars of damage and at least 4 fatalities, with locations at the bases of steep coastal bluffs being particularly hard-hit. An intense and unusually slow-moving storm in December 2007 produced not just an extended period of strong winds on the coast but also record-setting rainfall in southwestern WA, with as much as 14.35 inches recorded in a 24-hour period in the watershed of the Chehalis River. Landslides numbering at least in the hundreds were the consequence with numerous road closures (Fig. 2). The impacts of clear-cutting on some of the more major slides are still being sorted out. The wait was not long for another severe event that affected much of the state. January 2009 brought warm, drenching rains on the heels of wintry weather during late December 2008. An outcome was landslides from Cowlitz County in the south to Whatcom County in the north, with most of the damage of this sort in the Cascade Mountains. This event resembled that of 1996-97 in that it featured rain on snow at the locations of many of the slides. Perhaps snow on the ground is not just an additional source of water, but through its weight can also have a significant influence on the stability of slopes, especially ones near the threshold of failure.

Figure 2: The Pe Ell landslide of December 3, 2007. This slide blocked State Route 6 and damaged three structures (from the Department of Natural Resources: http://www.dnr.wa.gov/ResearchScience/Topics/GeologicHazardsMapping/Pages/landslides_dec07storm.aspx).

While the emphasis here is on the fast-moving landslides usually associated with rain, it is noted that these are not restricted to the west side of Washington state. The Okanogan Highlands extending from the North Cascades eastward to the Selkirk Mountains is one of the "landscape provinces" of WA. This region is subject to debris flows caused by thunderstorms, often in late spring through summer. Some of these have even produced damaging tsunamis on Lake Roosevelt behind Grand Coulee Dam. Our state is also subject to deep, slow-moving slides. A notable recent example of this sort is the Aldercrest-Banyon landslide that occurred near Kelso from 1998 into 1999. It resulted in 137 homes being condemned (about $70 million in total damage). While it was not due to a single weather event, it is hypothesized that above-normal precipitation during the 3-4 years preceding the slide was an important contributing factor.

At the time of this writing (late November 2013), there have already been a few minor slides this wet season even though there has not been much in the way of floods (at least yet). There are a variety of resources available online for readers interested in landslides (e.g., Fig. 3), particularly materials posted by Department of Natural Resources such as the following: http://www.dnr.wa.gov/Publications/ger_fs1_landslides.pdf. The Department of Ecology also provides information, with a focus on Puget Sound (http://www.ecy.wa.gov/programs/sea/landslides/maps/maps.html). Two products that are still in development use indices to track landslide likelihood – one is an online hazard map based on recent rainfall from DNR (https://fortress.wa.gov/dnr/landslidewarning/) and the other compares conditions to a landslide threshold for the Seattle area from USGS (http://landslides.usgs.gov/monitoring/seattle/rtd/plot.php). Both of these tools were developed in collaboration with the National Weather Service, which additionally provides Special Weather Statements regarding landslide threats beyond what these tools incorporate in the indices.

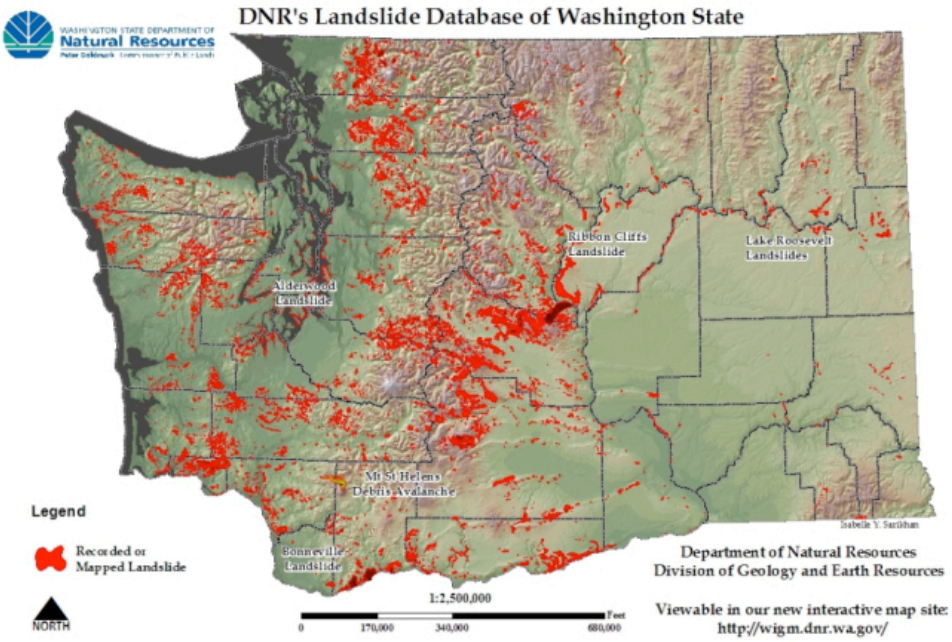


Figure 3: Mapped landslides from the Washington Interactive Geologic Map (http://www.dnr.wa.gov/geologyportal).

Snowpack Summary

The snow water equivalent (SWE) for the Olympic Mountains and the Cascades is below normal as of December 2, 2013 (Figure 4). The dry October and November conditions combined with the relatively warm mountain conditions has resulted in a slow start to the 2013-14 snowpack. The Olympic and Lower Columbia basins are only at 42 and 43% of normal snow water equivalent. The Central Puget Sound, South Puget Sound, Central Columbia, and Upper Yakima are all also below normal (between 50 and 69% of normal). The North Puget Sound and Lower Yakima basins are doing better but are still tracking below normal, with 85 and 72% of normal SWE, respectively. Finally, the basins in eastern WA are off to a good start with near-normal SWE in the Upper Columbia, and above normal SWE in the Spokane and Lower Snake.

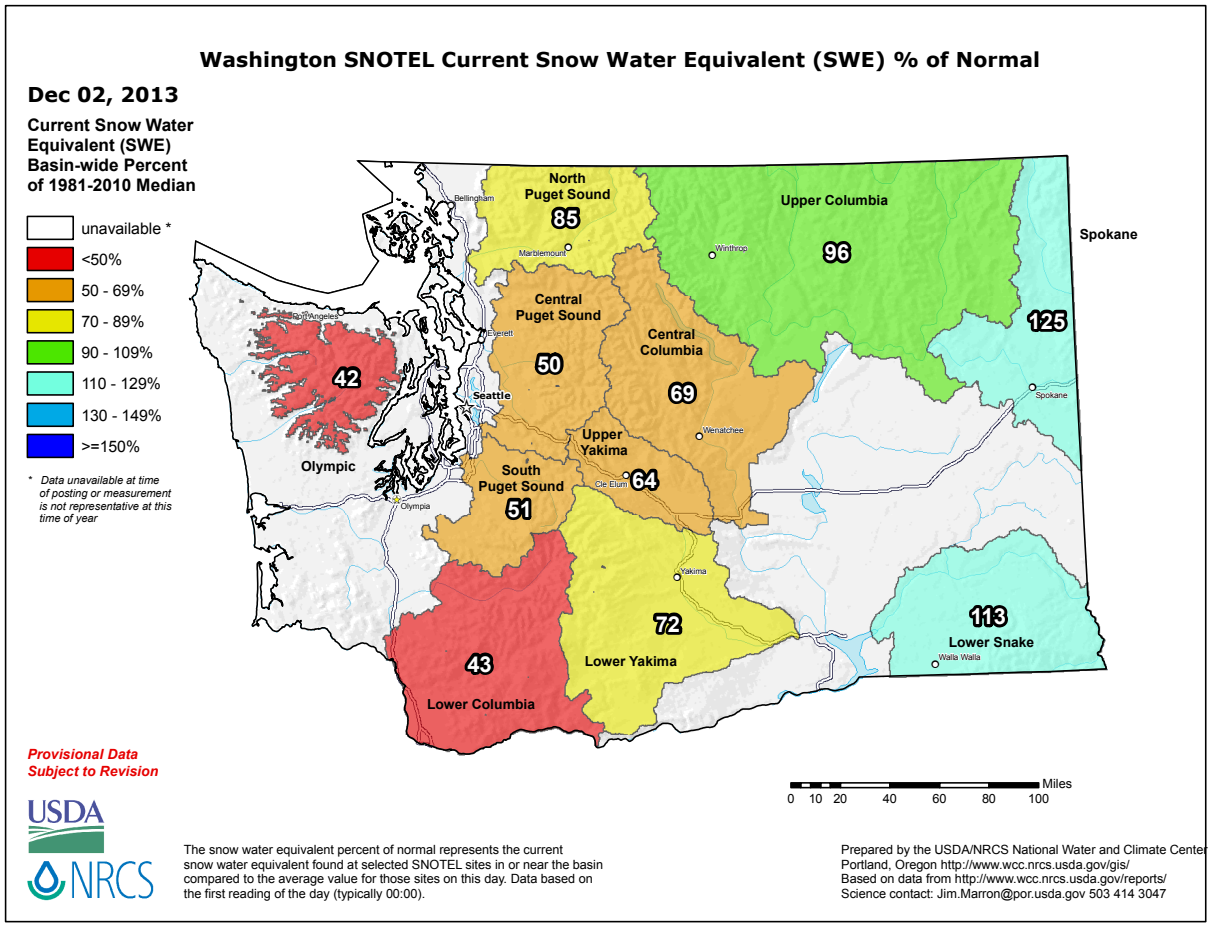
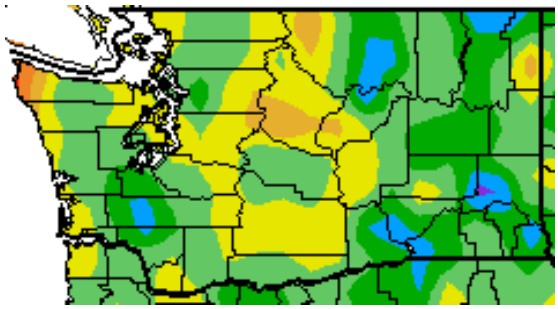


Figure 4: Snowpack (in terms of snow water equivalent) percent of normal for Washington as of December 2, 2013. Image is from the National Resources Conservation Service (NRCS).

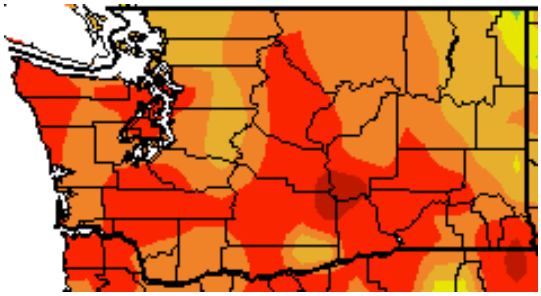
Climate Summary

Mean November temperature were near-normal across WA State, with a tendency towards colder than normal temperatures. The High Plains Regional Climate Center map shows areas of colder than normal temperatures mostly in eastern (e.g., Pasco and Omak; Table 2) and southwestern (e.g. Centralia) WA. The rest of the state was generally within 1°F of normal, except for some of the higher elevations in the Cascade Mountains and in Quillayute (3.4°F above normal; Table 2). Similar to October, the mountains were generally above the temperature inversion and fog with warmer than normal temperatures during the period of stagnant weather in the latter part of the month.

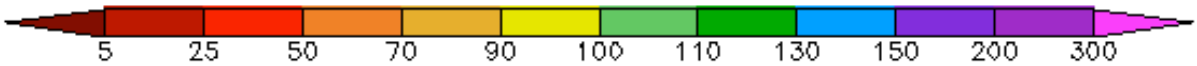
As was the case during October, total November precipitation was much below normal statewide. The precipitation percent of normal ranged between 25 and 70% of normal for a majority of the state with Wenatchee and Pasco relative dry spots with 27 and 37% of normal precipitation, respectively. A few areas, namely the northern Puget Sound and northeastern WA, received between 70 ad 90% of normal precipitation. Bellingham, for example, received 86% of normal November precipitation. Regarding snowfall, none fell in the western WA lowlands during November. Eastern WA saw some snow, and Spokane AP received about 42% of their average November snowfall.



Temperature (°F)



Precipitation (%)



November temperature (°F) departure from normal (top) and November 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	42.3	43.3	-1.0	4.69	8.63	54	0	0.9	0
Seattle WFO	46.0	46.2	-0.2	3.07	5.84	53	0	0.3	0
Sea-Tac	47.9	45.4	2.5	3.79	6.57	58	0	1.2	0
Quillayute	47.6	44.2	3.4	7.92	15.52	51	0	1.4	0
Hoquiam	45.7	45.8	-0.1	5.60	11.17	50	0	0.4	0
Bellingham AP	43.6	43.2	0.4	5.00	5.80	86	0	0.9	0
Vancouver AP	44.6	46.4	-1.8	2.83	5.91	48	0	M	-
Eastern Washington									
Spokane AP	34.8	35.7	-0.9	1.56	2.30	68	3.1	7.4	42
Wenatchee	37.4	37.6	-0.2	0.30	1.11	27	M	5.0	-
Omak	33.5	35.9	-2.4	0.99	1.81	55	M	M	-
Pullman AP	36.4	37.0	-0.6	1.78	2.29	78	M	M	-
Ephrata	37.2	37.0	0.2	0.59	1.06	56	M	2.6	-
Pasco AP	38.1	41.3	-3.2	0.40	1.09	37	0	M	-
Hanford	38.4	40.5	-2.1	0.36	0.95	38	0	2.0	0

Table 2: November 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) have been above normal in the western equatorial Pacific Ocean, and near-normal in the central to eastern equatorial Pacific. There is a consensus among the model predictions that near-neutral ENSO conditions will persist through the winter and spring 2014.

The CPC three-class outlook for December has increased chances of below normal (shaded blue) temperatures statewide. Cold air invaded the state during the first week of the month, and so far at least, this forecast looks pretty good. The outlook for December precipitation is a toss up: there are equal chances of above, equal to, or below normal precipitation statewide.

The three-month winter temperature and precipitation outlook for December-January-February (DJF) does not provide much to go on one way or another. The CPC outlook is indicating equal chances (EC) of below, equal to, or above normal temperatures and precipitation for the period.

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

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