



# Office of the Washington State Climatologist

## September 2017 Report and Outlook

September 7, 2017

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

### August Event Summary

For the 4th consecutive month, average monthly temperatures were warmer than normal statewide. Compared to previous Augusts, last month's mean temperatures ranked in the top 10% for most of the state, rendering them some of the warmest relative to normal (Figure 1). Averaged statewide, August had a mean temperature of 68.7°F, an impressive 4.0°F above the 1981-2010 normal and ranking as the warmest August on record.

Though August is typically dry in WA, it was markedly drier than normal with some locations reporting no measurable precipitation and most places with precipitation totals under 30% of normal (see "Climate Summary"). In fact, the summer months of June through August have seen some record stretches of no measurable precipitation at stations throughout the state. Table 1 shows some of the longest runs - most within the top 5 - from a few selected locations. At the time of writing (September 5), Spokane AP was still reporting no precipitation and is likely to break their long-standing record for consecutive days of no measurable precipitation (Table 1).

Several heat waves occurred throughout August, the first of which happened during the first week

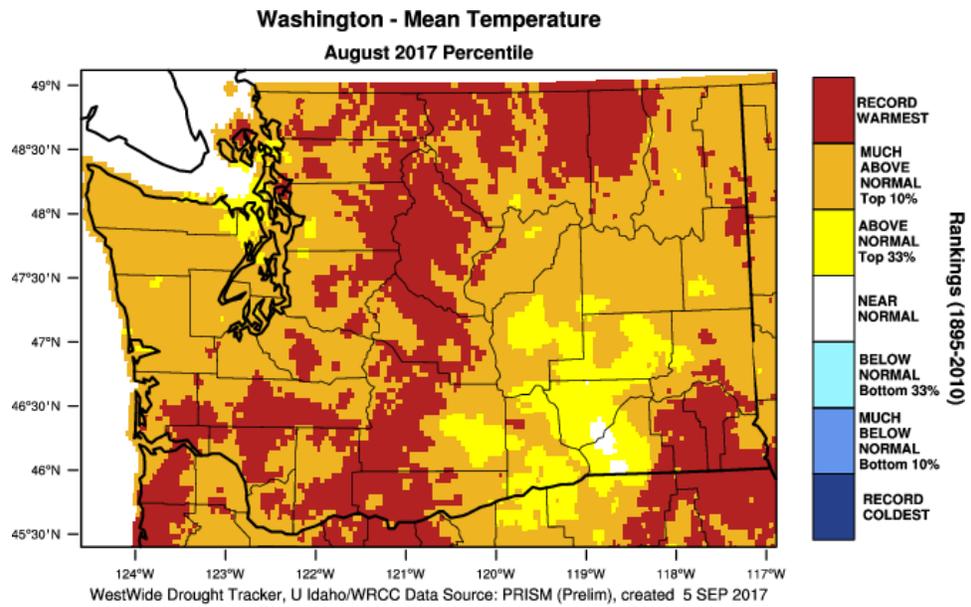
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of the month. Multiple locations - particularly in western WA - had new daily temperature records as follows: Quillayute (90°F) reported a new daily high temperature for the 1st, and SeaTac (91°F), Quillayute (98°F), and Hoquiam (89°F) for the 2nd. In the middle of the heat wave, a thick plume of wildfire smoke from British Columbia moved in. Air quality was generally poor both east and west of the Cascades, reaching "unhealthy" status in parts around Tacoma and in central WA. Despite the smoke, SeaTac (94°F), Seattle WFO (92°F), and Olympia (96°F) all reported new daily temperature records on the 3rd. The last day of the heat wave was the 4th, with temperatures

warm enough for Seattle WFO to report a new daily high temperature of 92°F.

A slight cool down in the middle of the month resulted in some scattered showers around central WA. On the 13th, Yakima reported a new daily precipitation total of 0.12". The rest of the month finished off much the way it started as a ridge of high pressure settled over the state. Quillayute (92°F) and Hoquiam (93°F) both reported new high maximum daily temperatures on the 27th and 28th and Yakima (99°F) on the 29th.



**Figure 1: August mean temperature percentiles for WA State (from WRCC).**

	Run Length	Rank	Dates	Records Began
<b>SeaTac</b>	55	1	6/18 - 8/11	1945
<b>Seattle WFO</b>	41	2	6/16 - 7/26	1986
<b>Vancouver</b>	57	1	6/17 - 8/12	1996
<b>Spokane*</b>	69	2	6/29 - 9/05	1881
<b>Pasco</b>	47	5	6/27 - 8/12	1945
<b>Quillayute</b>	22	6	6/21 - 7/12	1966

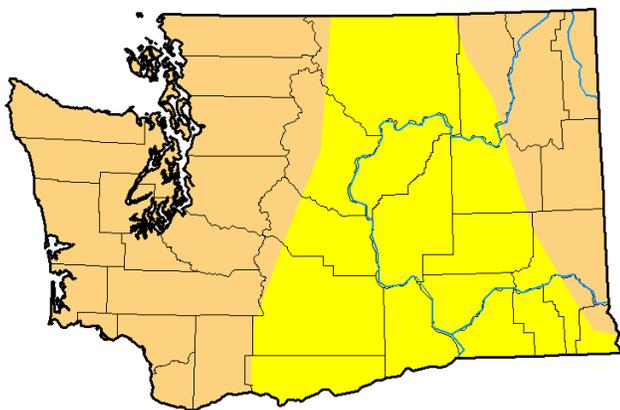
**Table 1: Number of consecutive days without measurable precipitation (<0.01"), rankings, date range of run length and the period of record for selected WA stations.**

**\*Note that at the time of writing (9/5/17), Spokane was still reporting no measurable precipitation and the rank is likely to change to first place in the next couple of days.**

# Drought and Streamflow Update

The persistent heat and dryness of this summer has worsened the WA state depiction on the US Drought Monitor (Figure 2). Conditions ranging from abnormally dry (“D0”) to moderate drought (“D1”) are now present across the entire state. This change is primarily due to the lack of precipitation this summer, though the heat and lower than usual streamflows in some locations have contributed as well. The 28-day average streamflows ending on September 3 from USGS are depicted in Figure 3. Streamflows west of the Cascades are generally much below normal, but most have not changed in eastern and central WA where some streamflows are above and even much above normal.

● D0 (Abnormally Dry)    ● D2 (Severe Drought)    ● D4 (Exceptional Drought)  
● D1 (Moderate Drought)    ● D3 (Extreme Drought)



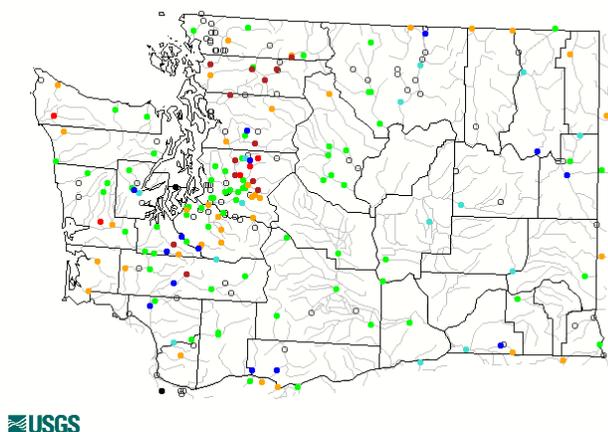
**Figure 2: The 7 September 2017 edition of the US Drought Monitor.**



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 and submit your observations. While it might feel tedious, we highly encourage you to use the “Observation Notes” text entry in daily reports. It doesn’t have to be too long, just a few quick notes on the weather or any sudden changes in temperature and precipitation. These observations help provide a more complete picture of the daily weather and also allow you to keep track of how weather in your area changes throughout the month. You can also read over other observer’s daily comments by going to: <https://www.cocorahs.org/ViewData/ListDailyComments.aspx>



Explanation - Percentile classes							
●	●	●	●	●	●	●	○
Low	<10 Much below normal	10-24 Below normal	25-75 Normal	76-90 Above normal	>90 Much above normal	High	Not-ranked

**Figure 3: The 28-day average streamflow as of 3 September 2017 for WA. From USGS.**

## On the “Great American Solar Eclipse”

### A message from the State Climatologist

While not a meteorological phenomenon, the historic “Great American Solar Eclipse” passed over the US on August 21, offering a view of at least a partial solar eclipse for the entire country, and deserves mention in this newsletter. Totality – when the moon completely covers the sun – was experienced in a 70-mile band from Oregon to South Carolina. Whether choosing to stay in WA to view the partial eclipse or traveling to other states to the south to experience totality, it can certainly be classified as the scientific buzz of the summer. Here we review the meteorological conditions in the Pacific Northwest during this exciting event.

After several weeks of postulating about potential cloud cover during the highly anticipated event, the weather was spectacular throughout the Pacific Northwest! The point in which the moon obscured most of the sun was around 10:20 am throughout the region, so there was valid concern

that a marine layer could block the view west of the Cascade Mountains. Once the event became closer and forecasts were available, however, it looked like cloud cover would not be an issue. Figure 4a shows the column-integrated cloud water forecast made on August 16, 5 days before the event, with some clouds on the coast, but clear skies for the rest of the Northwest. An infrared satellite image at 10:15 am on August 21 shows that the clear skies verified, with clear conditions even on the coast (Figure 4b).

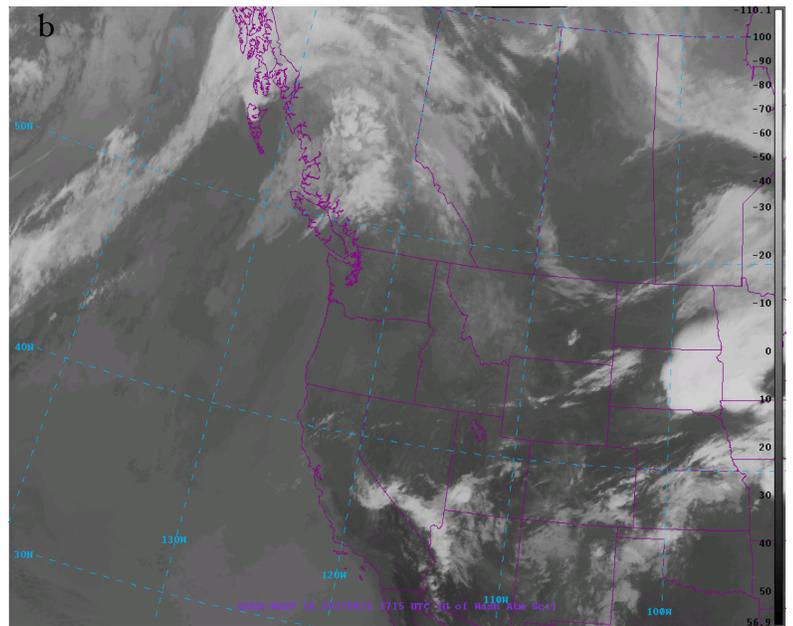
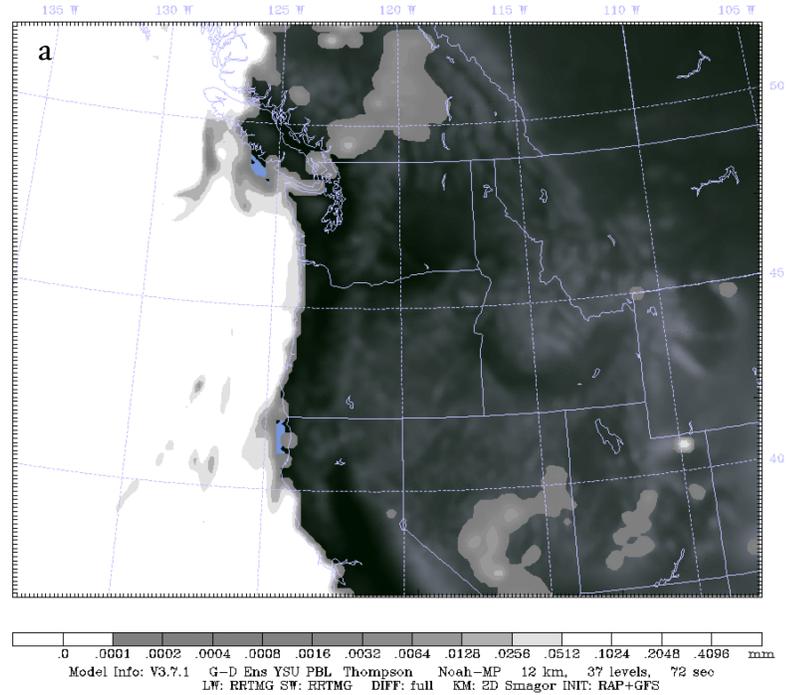
Figure 5 shows high-resolution temperature and solar radiation data for 3 sites in the Pacific Northwest. The John Day Climate Reference Network station in Oregon was in the path of totality and is east of the Cascade crest – 5-minute data are available. The Goldendale Agrimet station is in eastern WA, has 15-minute data available, and experienced 98% totality. Finally, the roof of the Atmospheric Sciences building on

the University of Washington campus in Seattle has 1-minute data available and experienced 92% totality. We averaged the UW Roof data to 5-min data for ease of plotting.

A clear dip in temperatures is seen for all 3 sites beginning at about 9:50 am as the moon obscures part of the sun. The largest temperature drop of our 3 sites occurred unsurprisingly at John Day with a 4.8°F temperature signal during the eclipse (CRN analysis: <http://www.atdd.noaa.gov/crn-eclipse/>). The UW Roof and Goldendale saw a temperature drop of 4.0°F and 3.2°F, respectively. Goldendale has the lowest resolution data (15-minute) so we suspect that the temperature likely fell more than that during the event since it was at 98% totality. Overall, while notable and likely felt by eclipse watchers (ourselves at OWSC included!), these are modest temperature changes. Several analyses show that there were larger temperature drops in the eastern US during the event. One such analysis was done by Joe Zagrodnik of the UW Atmospheric Science Department and showed up to 10°F temperature drop for some National Weather Service stations with 5-minute data during totality in the eastern US. This is likely because the event occurred at a later – and warmer – part of the day in the central and eastern time zones.

The solar radiation for the day also shows a very clear marker of the event, and includes a rather quick return to “normal” values at the end of the event. Minimum solar radiation values of 30 W/m<sup>2</sup>, 26.9 W/m<sup>2</sup>, and 1 W/m<sup>2</sup> were measured at the UW Roof, Goldendale,

UW WRF-GFS 12km Domain      Init: 00 UTC Wed 16 Aug 17  
 Fcst: 138 h      Valid: 18 UTC Mon 21 Aug 17 (11 PDT Mon 21 Aug 17)  
 Column-integrated cloud water (mm) + Model terrain



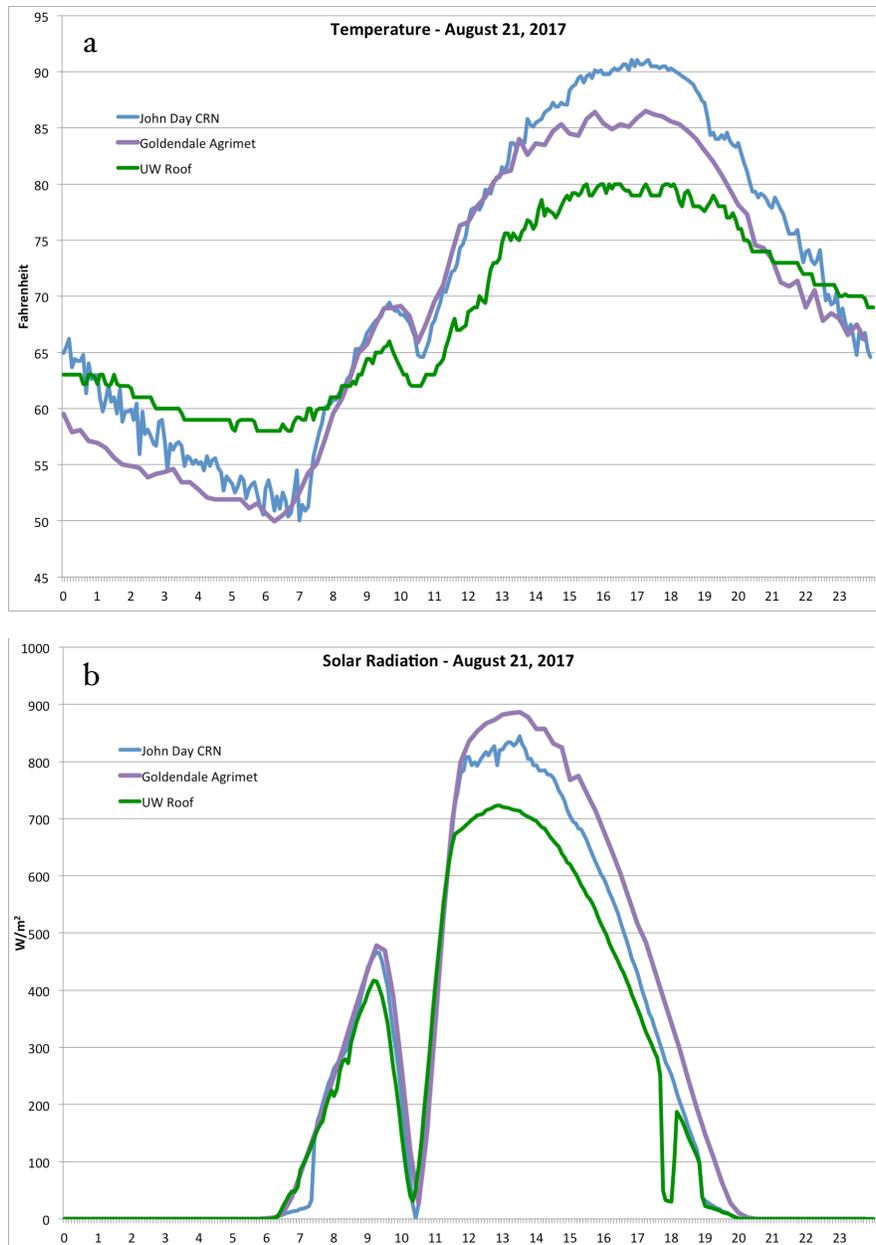
**Figure 4: A forecast for integrated cloud water column on the day of the eclipse initiated on August 16 from the University of Washington WRF system (a) and an infrared satellite image from 10:15 am on the day of the eclipse (b).**

and John Day, respectively, during the peak of the event. These values represent a drop of about 500-600 W/m<sup>2</sup> in solar radiation from where they would have been if the eclipse did not occur that day.

Many of our state climatologists partners run weather networks and were watching this event

closely as well. If you found this piece interesting, then there are several websites dedicated to the eclipse observations worth checking out.

Examples include observations from Kentucky (<http://kymesonet.org/eclipse.html>), Kansas (<http://mesonet.k-state.edu/special/eclipse/>), and North Carolina (<http://climate.ncsu.edu/eclipse2017>).

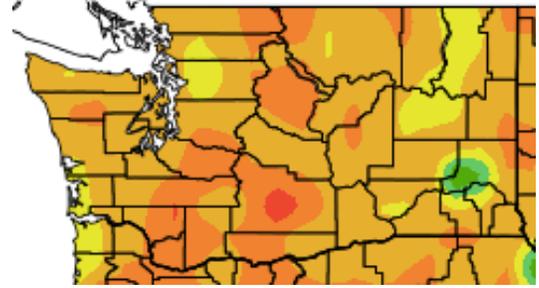


**Figure 5: High resolution temperature (a) and solar radiation (b) observations for John Day CRN, Goldendale Agrimet, and the UW Roof on August 21, 2017.**

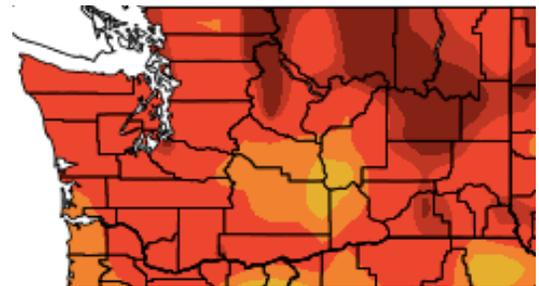
# Climate Summary

Mean August temperatures were warmer than normal across the entire state. Generally, most lowland locations were within 4°F of normal, but there were greater positive anomalies at higher elevations and in the eastern part of the state. Spokane and Pullman were especially warm spots, with temperatures 4.5 and 4.3°F above normal, respectively (Table 2). Temperatures west of the Cascades were less dramatic, though there were some exceptions. For example, SeaTac and Vancouver had mean temperatures of 4.2 and 3.7°F above normal, making the temperature anomalies some of the largest in the state.

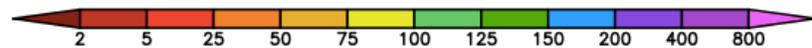
Total August precipitation totals were minimal with most places receiving no more than 25% of normal. Some locations in eastern WA such as Spokane and Omak, had no measurable precipitation for August. Other spots, particularly in central WA, fared slightly better. Wenatchee, Ephrata and Hanford all received about 0.10" of precipitation which represented 30 to 33% of normal (Table 2).



Temperature (°F)



Precipitation (%)



**August 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)		
	Average	Normal	Departure from Normal	Total	Normal	% of Norm
Western Washington						
Olympia	67.3	64.1	3.2	0.11	0.94	12
Seattle WFO	69.7	66.5	3.2	0.21	0.97	22
SeaTac AP	70.3	66.1	4.2	0.02	0.88	2
Quillayute	62.2	59.6	2.6	0.46	2.49	18
Hoquiam	62.7	60.6	2.1	0.26	1.31	20
Bellingham AP	65.2	62.5	2.7	0.09	1.23	7
Vancouver AP	72.9	69.2	3.7	0.10	0.77	13
Eastern Washington						
Spokane AP	73.8	69.3	4.5	T	0.59	0
Wenatchee	76.9	73.5	3.4	0.06	0.20	30
Omak	75.6	72.4	3.2	T	0.49	0
Pullman AP	70.2	65.7	4.5	0.07	0.63	11
Ephrata	77.2	72.9	4.3	0.06	0.19	32
Pasco AP	74.9	72.8	2.1	0.05	0.27	19
Hanford	79.4	75.8	3.6	0.06	0.18	33

**Table 2: August 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.**

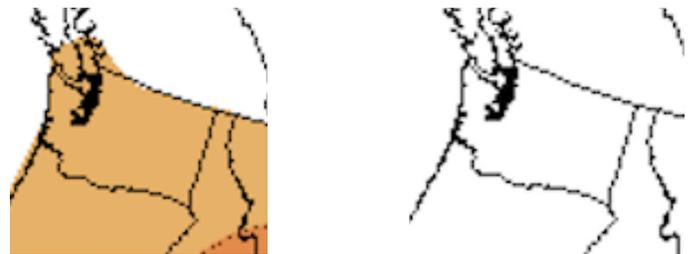
# Climate Outlook

ENSO-neutral conditions are still present in the equatorial Pacific, according to the Climate Prediction Center (CPC). Sea surface temperatures across the central and eastern Pacific have decreased over the last month and are currently near to below average. Current models are favoring ENSO-neutral conditions (85%) to continue through fall 2017, but decrease to roughly 55% for winter 2017-18.



**September outlook for temperature (left) and precipitation (right)**

The CPC seasonal outlook for September is calling for increased chances of above average temperatures statewide, with odds exceeding an impressive 70% for eastern and central WA. For precipitation, there are higher chances of below normal precipitation throughout the state.



**September-October-November outlook for temperature (left) and precipitation (right)**

The September-October-November (SON) CPC outlook is calling for above normal temperatures statewide. Precipitation is a toss-up for the entire state - there are equal chances of below, equal to, or above normal precipitation totals for SON.