Office of the Washington State Climatologist

February 2022 Report and Outlook

February 7, 2022

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

January Event Summary

Average January temperatures were below normal for a majority of Washington State, especially at the lower elevations. There was considerable spatial variability in total January precipitation across the state. There was also a big difference in timing; the first half of January had a more active weather pattern with wetter conditions compared to the second half. This is illustrated in Figure 1, showing the daily January 2022 temperatures and precipitation for SeaTac Airport.

The cold spell at the end of December continued into the new year, and daily record low minimum temperatures were set on the 1st at Bellingham (8°F) and Pasco (-7°F). Heavy mountain snow caused all 4 mountain passes to close for several days beginning on January 6 (KING5). White and Stevens Pass closed for an entire week, while

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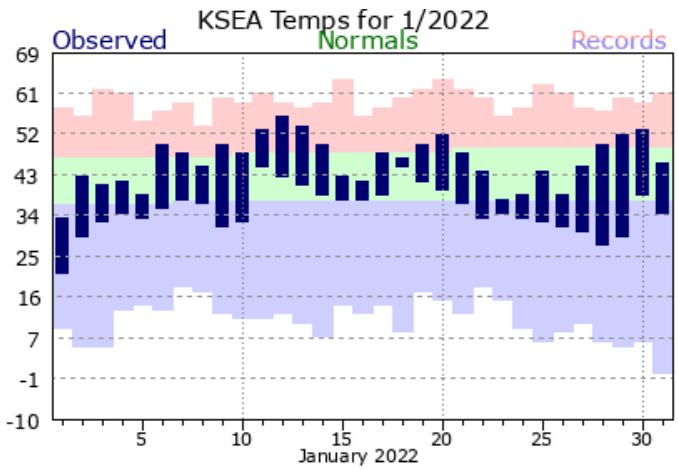


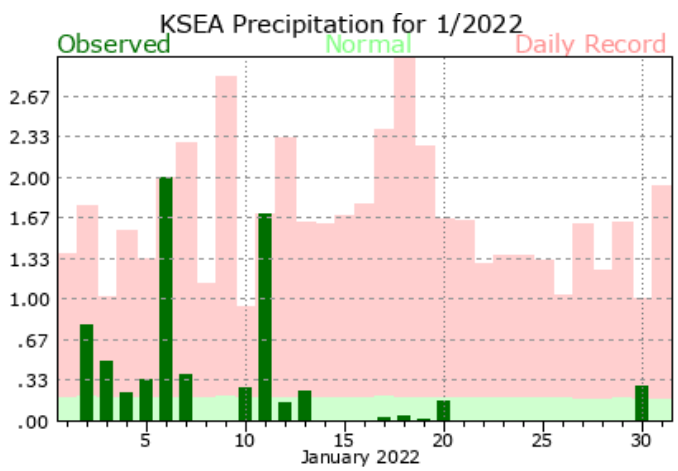


Figure 1: January 2022 daily temperature and precipitation for Sea-Tac Airport compared to the 1991-2020 normal (green envelope)and previous records (blue and red envelopes; NWS).

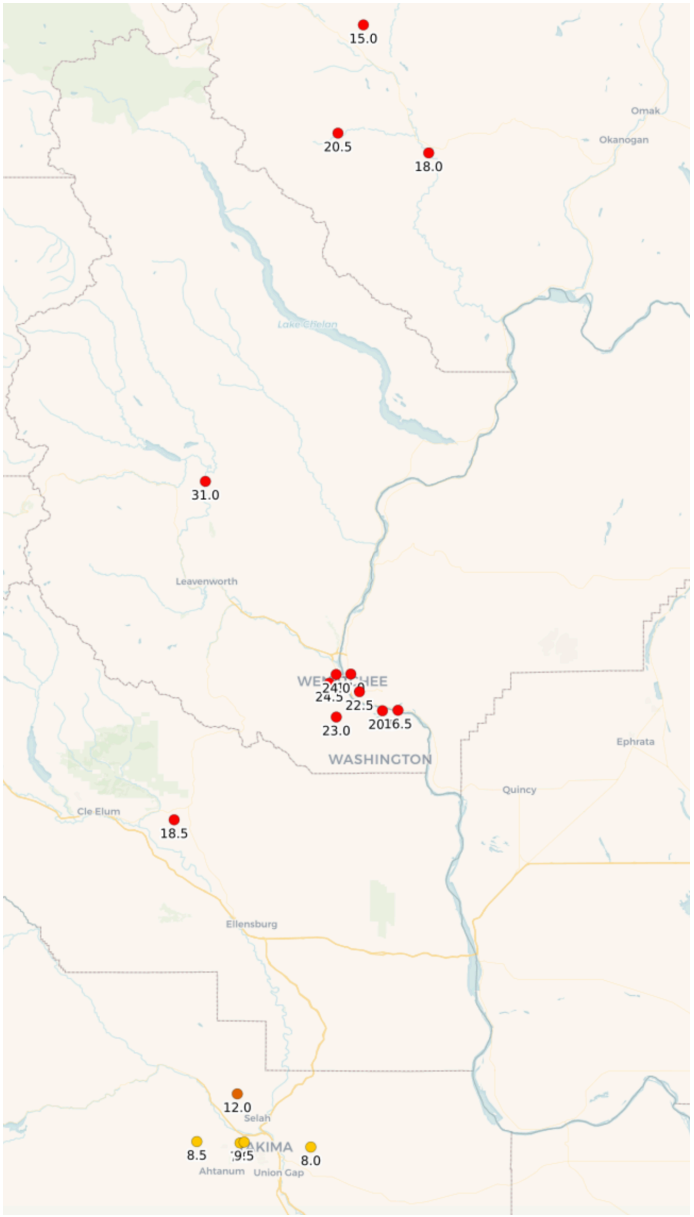


Figure 2: 24-hour snowfall measurements on the morning of January 6, 2022 from the CoCoRaHS network.

Snoqualmie and Blewett reopened after 3 days. According to 24-hour snowfall observations ending on January 6 from CoCoRaHS observers (Figure 2), the Wenatchee area saw 20-25" of snow with a remarkable 31" observation north of Leavenworth. Both the Wenatchee Exp station and the Wenatchee Water Treatment Plant set all-time records for the 24-hr snowfall ending on the 6th with 23.3" and 23.0", respectively. Leavenworth declared a state of emergency of the 7th due to the massive amounts of snow and the difficulty removing it.

The precipitation on the 6th fell as rain in western WA and set maximum daily precipitation records at Hoquiam (5.78"), Olympia (3.99"), and SeaTac (2.00"). The 5+ inches that fell at Hoquiam ranks as the highest 24-hr precipitation observation since records began in 1953. For Olympia, the January 6th total ranks as the 6th highest on record (behind the 4.82" on 1/7/2009). Maximum precipitation records were set east of the Cascade crest on the 6th, but they all reflect the liquid equivalent of snowfall: for example, Pullman (0.83"), Wenatchee (0.81"), Ellensburg (0.75"), and Ephrata (0.23").

Active weather and mountain snow continued during the second full week of January. Hoquiam (2.84") and SeaTac AP (1.70") set more daily maximum precipitation records on the 11th as another atmospheric river impacted the state. But then there was a pattern shift, resulting in the second half of the month being relatively dry. A ridge of high pressure brought temperature inversions, with warmer than normal temperatures in the mountains and below normal temperatures in the lowlands. This period was accompanied by frequent fog and air stagnation advisories.

Snowpack and Drought Summary

Snow water equivalent (SWE) in the Olympic and Cascade Mountains continued to grow throughout January. Mountain stations gained anywhere from 3 to 20" of SWE during the month. The basin average SWE percent of median from NRCS as of February 1 (Figure 3) indicates normal to above normal SWE for most of the state. The Lower Columbia and Central Puget Sound basins have the highest SWE relative to normal, with 108 and 103% of normal, respectively. Basin average snowpack is below normal in both the Olympic (89% of normal) and Lower Yakima (86% of normal) basins.

There was very little change to the U.S. Drought Monitor since the last edition of our newsletter. Some of the area of "moderate drought" was removed from western Yakima and Klickitat counties. While snowpack remains in relatively good shape, there are longer term precipitation deficits in eastern WA from last spring and summer - and even longer in some locations - that have yet to fully rebound.

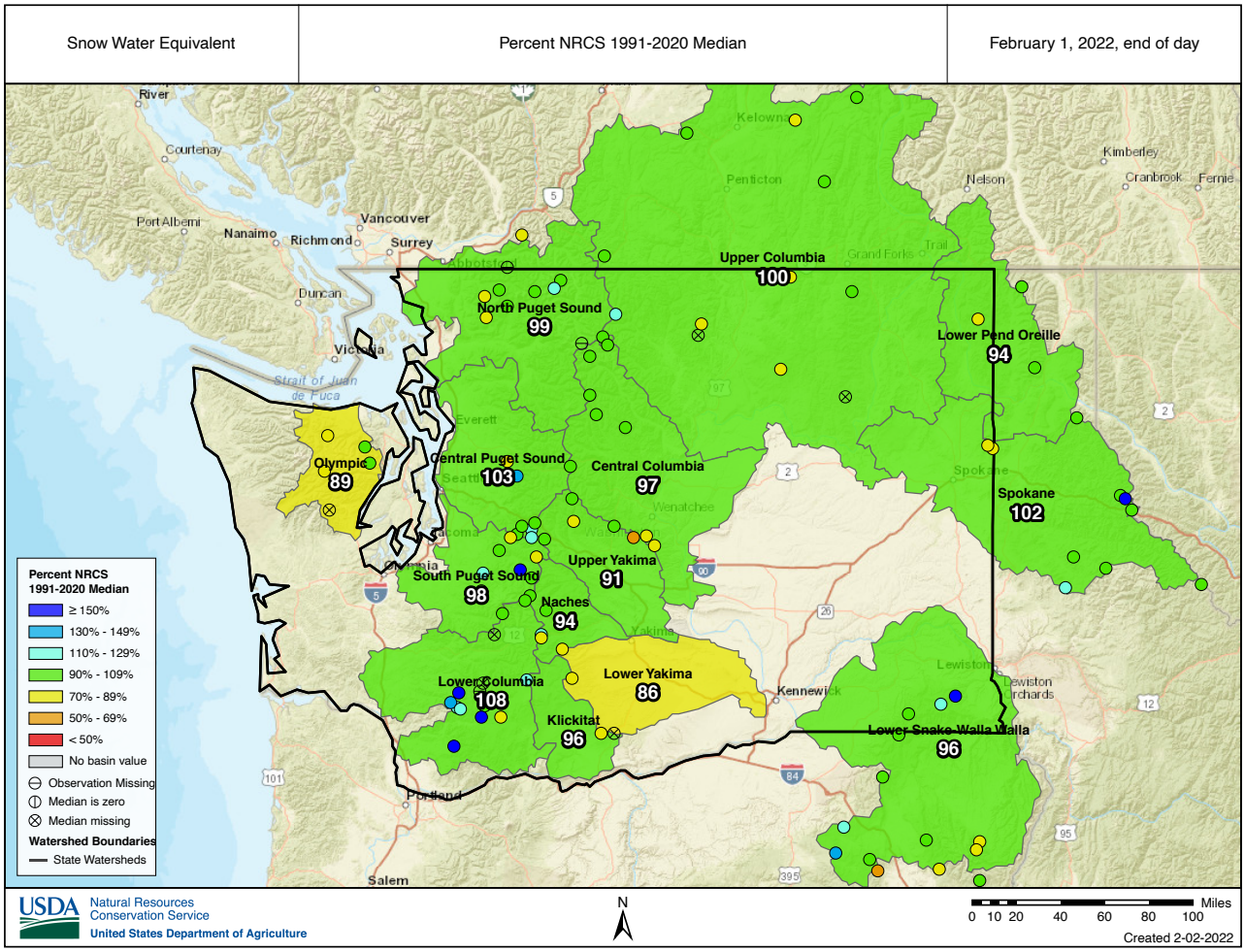


Figure 3: Snowpack (in terms of snow water equivalent) percent of median for WA as of February 1, 2022. The median is based on the 1991-2020 period (NRCS).

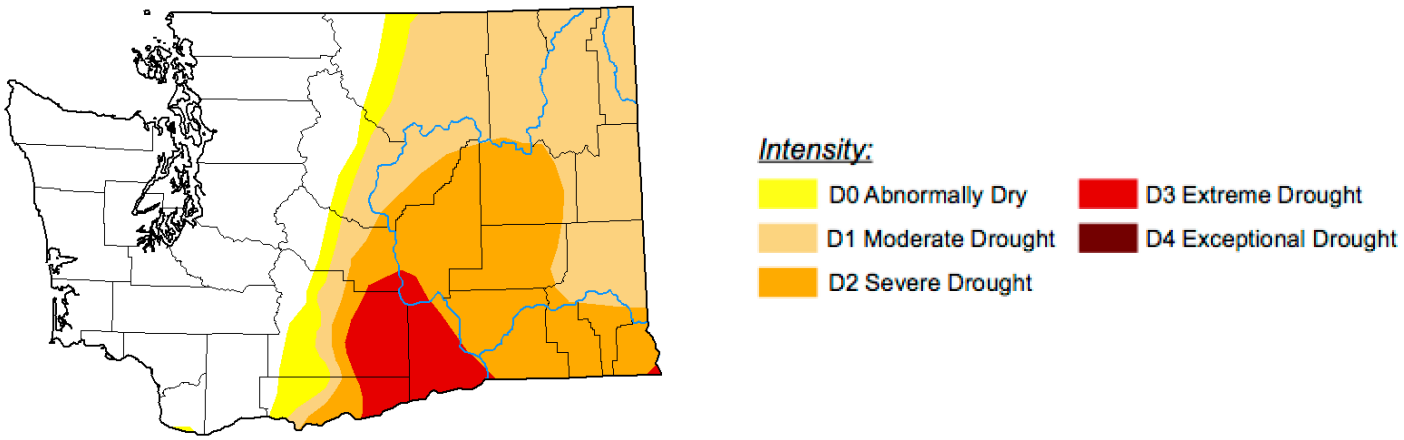


Figure 4: The February 3, 2022 edition of the U.S. Drought Monitor.

Community, Collaborative Rain, Hail, and Snow (CoCoRaHS) Corner

Did keeping up with CoCoRaHS observations make it onto your list of New Year's Resolutions? Or something vaguer, like "contribute to citizen science efforts"? Maybe you're not one for resolutions, but instead you're looking for a nice daily bonding activity for you and your partner this Valentine's Day. Any reason is a good reason to join the Washington CoCoRaHS network! If you want more information and would be interested in measuring your daily backyard precipitation totals for the good of all, visit the CoCoRaHS website.

Members of the Washington CoCoRaHS network steadfastly recorded 98% of the number of last month's observations, ending January with a grand total of 10,981 observations. Only 51% of observations recorded some amount of precipitation, a sharp drop from the previous month. Nine new members joined the Washington network in the month of January (welcome!). Grays River, WA earned the title of the state's highest one-day total for the month, with 6.41" recorded on 1/12/2022.

Condition monitoring reports in the month of January reflected the diversity of precipitation totals seen in the Climate Summary (page 8). Observers in Okanogan, Stevens, and Snohomish Counties described some days and weeks as "dry," while stations in Pierce and King Counties reported minor flooding. Snow remained part of the landscape throughout the eastern half of the state; some folks in Okanogan County reported over 20" of snowpack on the ground in the latter half of the month. Still others reported icy conditions, extreme cold, fog, temperature inversions, avalanches, and excellent skiing conditions at different times during the month. It sounds like there wasn't a dull moment!

Real-time Monitoring of the Climatic and Oceanic Forcing of the Waters of Puget Sound

A Message from the State Climatologist

Under the auspices of the Puget Sound Ecosystem Monitoring Program (PSEMP), with the support of the Puget Sound Partnership (PSP), a real-time system named the "Puget Sound Metrics Dashboard" has been developed to keep track of leading climatic and oceanic factors impacting Puget Sound's water properties. This system is maintained by the Northwest Association of Networked Ocean Observing Systems (NANOOS) and as stated on its website, the intention is "to inform resource managers, scientists, health officials, and others" on current Puget Sound conditions. The specific metrics included relate to the strength of flows due to density differences, the exchange of heat at the air-sea interface, the effects of rain and streamflows on salinity, water column oxygen concentrations, and water properties on the Northwest WA shelf (which represent boundary conditions for the inland waters). The various metrics are updated weekly, and put in a climatological context based on past observations. Full descriptions of these metrics can be found on the dashboard at nanoos.org/products/ps_metrics/home.php.

The OWSC was involved in the development of this monitoring system, with a focus on the component involving heat fluxes at the surface of Puget Sound. These fluxes are estimated for a North Sound region to the west of Whidbey Island, and a Central Sound region, as shown by the hatched areas on Figure 5. The locations of the observations that are used to specify the fluxes are also shown in Figure 5. Multiple station networks are used; the downward shortwave radiative fluxes

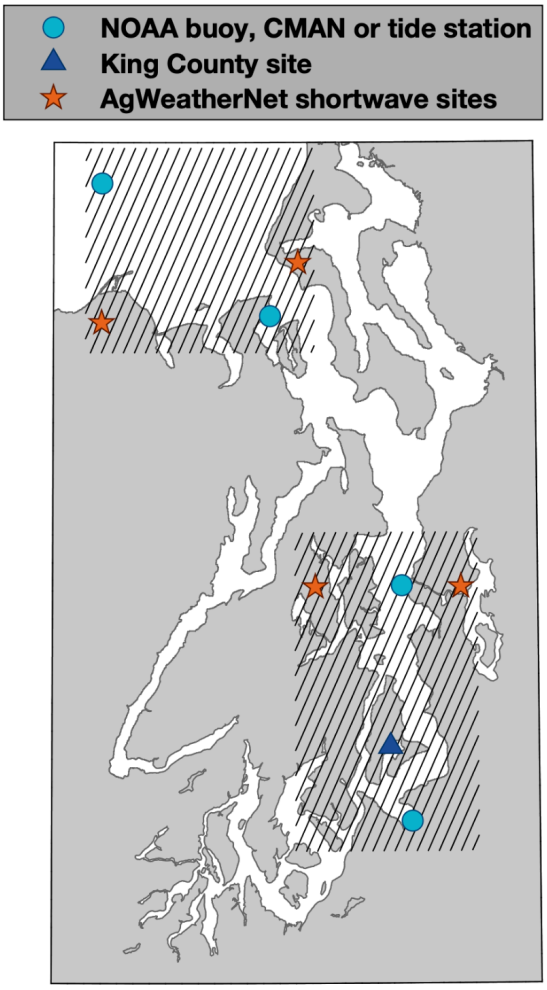


Figure 5: The locations of the "North Sound" and "Central Sound" regions (hatched areas) and the observations used to calculate the fluxes (Puget Sound Metrics Dashboard).

are from AgWeatherNet stations on land, and the air temperatures, water temperatures, and wind speeds are from NOAA buoys, Coastal-Marine Automated Network (CMAN) stations, and tide stations. The net longwave radiation is estimated using the measured incoming solar radiation (insolation) as compared with clear-sky values to estimate cloud fractions, sea-surface temperature (SST), surface air temperature, and water vapor

pressure, following Reed (2003). The sensible and latent heat fluxes are calculated using the "Lake Metabolizer" package in R. Detailed information on the methods used are on the dashboard's website at the following url: nwem.ocean.washington.edu/PSmetrics/Surface_Heat_Flux_Calculations.pdf.

Figure 6, an example of what can be found on the dashboard, shows the net heat fluxes for the North Sound region as compared with climatological values for the period of late January 2021 through late January of this year. This time series has a variety of interesting features. For starters, in the climatological average – which incidentally includes some week-to-week variability associated with these averages being calculated over only 7 years by necessity – it is obvious that there is substantially more total heat gained by the ocean from spring through early fall than heat lost in the winter. Given this asymmetry, why do the water temperatures not just get warmer and warmer over time? The answer relates to the estuarine circulation that drives the exchange of the inland waters with those of the Pacific Ocean. In simple terms, the inflow is mostly colder water at depth with the outflow being warmer water near the surface and so in a net sense there must be a net heating of Puget Sound. With regards to the net heat flux anomalies estimated over the last year or so, the warm weather of spring through early summer 2021 is reflected by mostly positive heat flux anomalies interspersed with a few short and minor intervals of less heating than usual for the time of year. The greatest cooling, from both actual and anomalous perspectives occurred near the end of December 2021 into 2022 in association with unusually cold temperatures in western WA.

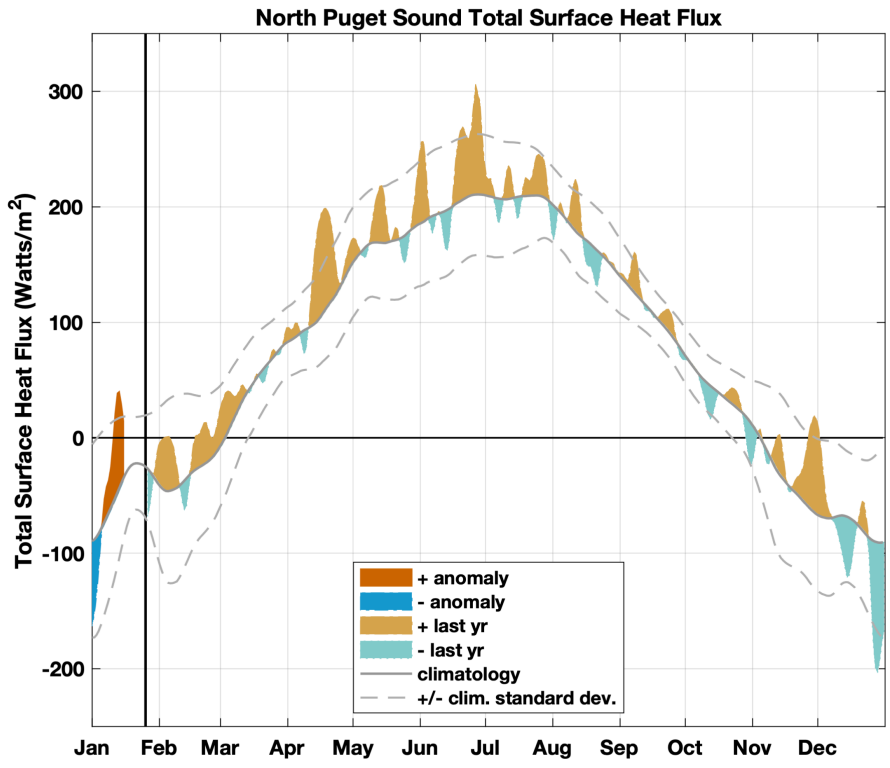


Figure 6: February 2021-January 2022 total surface heat flux for the North Puget Sound region compared to a 7-year climatology (Puget Sound Metrics Dashboard).

The dashboard includes a portrayal of the past year's downward shortwave radiation, and an example of a recent screen shot is shown in Figure 7. Note that in the climatological average that this component of the surface heat fluxes has a peak in mid-July. While there is more clear-sky insolation at the time of the summer solstice, there also tends to be greater cloudiness in June than in July, resulting in a delay in the climatological peak heating. But many probably remember that late June of 2021 did not just feature a record-setting heat wave but also mostly cloud-free days, as reflected by shortwave heat flux values that reached their greatest for the year

with values exceeding 50 W/m² above normal. The fall and winter seasons are generally cloudy in the vicinity of Puget Sound but the time series of Figure 7 shows it was even gloomier than usual during the last three months of 2021. That being said, whether it is cloudy or clear does not have much of an impact on the net heating in the winter, with the magnitude of the anomalies on the order of only 20-30 W/m². Moreover, clouds generally result in greater downward longwave radiation (not shown) that compensates for the lack of insolation. The residents of the Puget Sound region probably appreciate this in a related way, namely that the amount of sunshine in winter has little correspondence with air temperatures.

The dashboard was designed as a resource for individuals keeping track of the Puget Sound ecosystem and water quality; hopefully the regional climate community will also find it interesting and useful. We conclude this piece with recognition of the efforts of co-investigators Beth Curry, John Mickett (lead PI) and Jan Newton with the Applied Physics Laboratory of the University of Washington (Beth is now with MRV Systems, LLC). Special kudos go to John for all of the extra time he expended working with NANOOS towards putting our separate pieces together into a cohesive, real-time system.

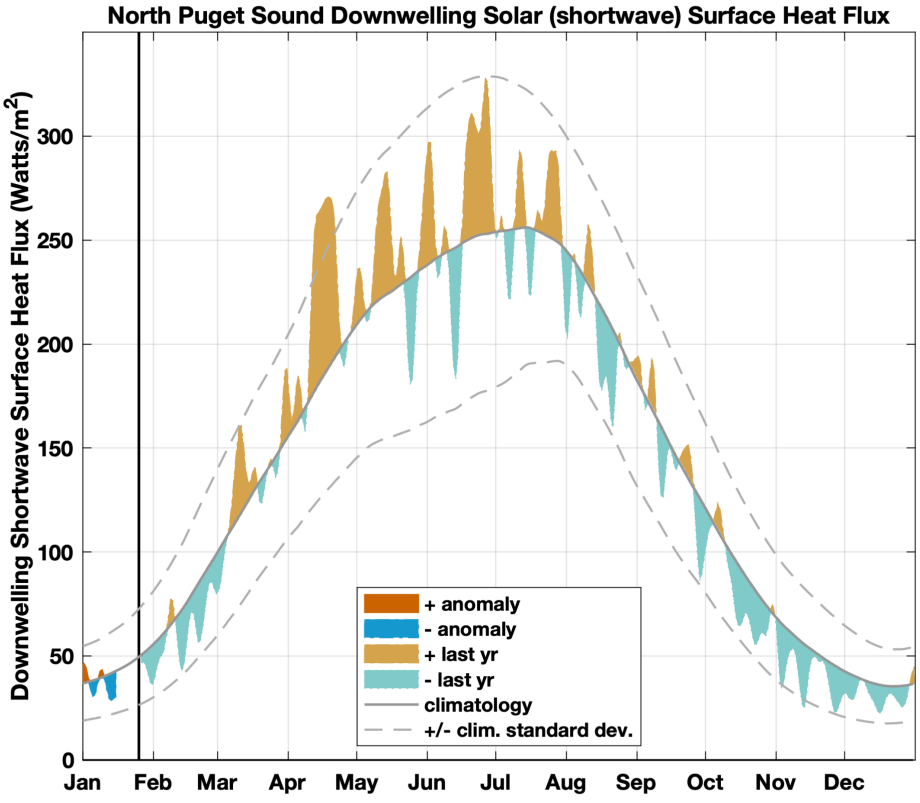
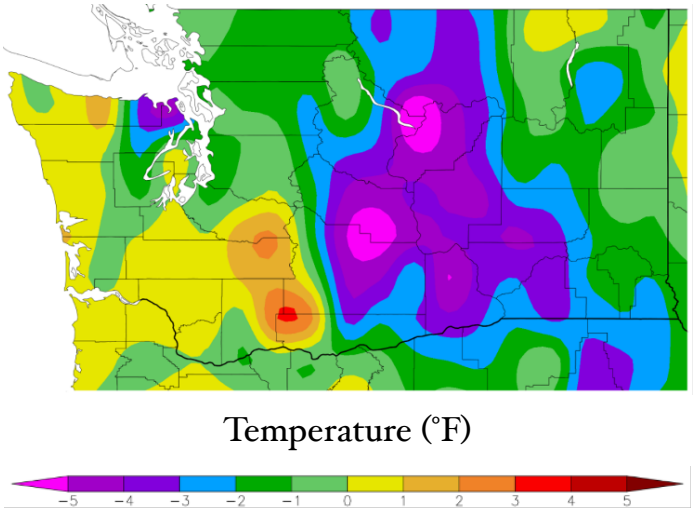


Figure 7: February 2021-January 2022 downwelling solar surface heat flux for the North Puget Sound region compared to a 7-year climatology (Puget Sound Metrics Dashboard).

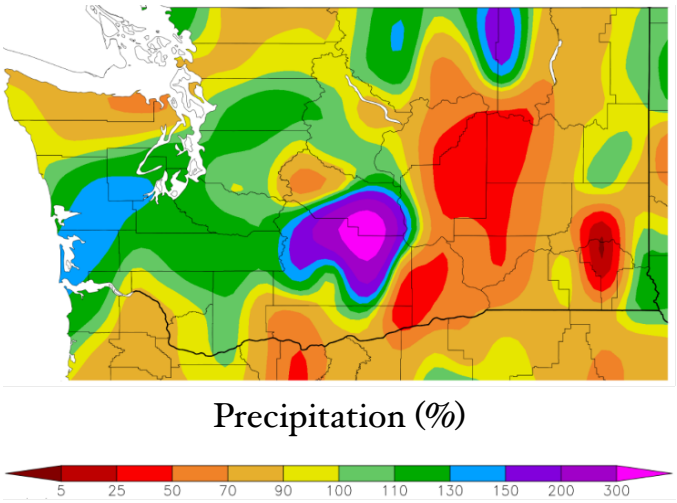
Climate Summary

Average January temperatures were around or below normal for most of the state, as seen in the map from the High Plains Regional Climate Center. West of the Cascades, most stations recorded average temperatures within 2˚F of normal (Table 1). A notable exception is the northeast corner of the Olympic Peninsula, which was much colder than normal; Sequim, for example, was 4.2˚F below normal. Areas east of the Cascades recorded similarly chilly temperatures, with some stations up to 5˚F below normal. Central Washington was colder than eastern Washington. Within the southern half of the Cascades themselves and at some of the higher elevations of the Olympic Mountains, observed temperatures were more notably above normal. As an example, Paradise on Mount Rainier, recorded an average January temperature 3˚F above normal of 32˚F.

Precipitation anomalies were quite variable throughout the state for January. In western Washington, the southern half of the Olympic Peninsula and the central and southern Puget Sound region recorded monthly precipitation totals around 130% of normal precipitation. Selah, located just north of Yakima, received 12.23" of precipitation for the month as a whole – compared to a norm of just 1.07"! Yakima Airport, in contrast, only received 1.39", despite being only a handful of miles away. Republic, on the border of Okanogan and Ferry Counties, received a healthy surplus, specifically 162% of its normal precipitation. Parts of Washington farther southeast were not so lucky. Odessa, Ephrata, and other stations near the junction between Grant, Lincoln, and Adams Counties saw under 50% of normal precipitation (Table 1). Outside of these exceptions, most of the state received near-normal precipitation.



January temperature (˚F) departure from normal relative to the 1991-2020 normal (HPRCC).



January total precipitation percent of 1991-2020 normal (HPRCC).

Station	Mean Temperature (°F)			Precipitation (inches)		
	Average	Normal	Departure from Normal	Total	Normal	Percent of Normal
Western Washington						
Olympia	41.5*	39.6	1.9	10.78	7.80	138
Seattle WFO	41.4	42.3	-0.9	6.50	5.14	126
SeaTac AP	41.0	42.8	-1.8	7.06	5.78	122
Quillayute	41.8	41.7	0.1	16.63	15.59	107
Hoquiam	44.1	42.8	1.3	15.42	10.91	141
Bellingham AP	39.7	40.2	-0.5	2.30	4.49	51
Vancouver AP	40.5	40.7	-0.2	4.75	5.34	89
Eastern Washington						
Spokane AP	29.3	29.6	-0.3	2.13	1.97	1.08
Wenatchee	24.8	28.9	-4.1	1.18	1.02	116
Omak	24.6	28.0	-3.4	0.91	1.33	68
Pullman AP	30.6	32.7	-2.1	2.45	2.15	114
Ephrata	25.2	29.6	-4.4	0.37	0.91	41
Pasco AP	31.7	34.6	-2.9	0.53	1.03	51
Hanford	30.0	33.3	-3.3	0.50	1.01	50

Table 1: January 2022 climate summaries for locations around Washington with a climate normal baseline of 1991-2020. *Temperatures at Olympia Airport appear to be running warmer than some surrounding stations during the second half of January, making this observation potentially unreliable. We will continue to monitor this station and post updates, as needed.

Climate Outlook

According to the Climate Prediction Center (CPC), La Niña conditions are present in the Pacific Ocean, and a "La Niña Advisory" remains in effect. Over the last 4 weeks, sea surface temperatures (SSTs) in most of the eastern equatorial Pacific Ocean have been below average, but the anomaly has weakened. Above average SSTs remain in the western equatorial Pacific Ocean. La Niña conditions are likely to persist through the end of spring (67% chance for the March-May season). Neutral ENSO conditions are more likely to emerge in the springtime or beginning of summer than anything else (51% chance for the April-June season, up from 41% last month).

The CPC outlook for February (Figure 8) shows 40-50% chances of below normal temperatures for the northern half Washington state. The southern half also is projected to be on the cool side, with slightly lower chances (33-40%). There are equal chances of below, equal to, or above normal February precipitation statewide.

The three-month outlook for February-March-April (FMA) shown in Figure 9 predicts below normal temperatures statewide, with chances between 40 and 50% for the entire state. Similarly, the entire state is forecast to receive above-normal precipitation totals. The northeastern half of the state has a 40 to 50% chance of experiencing above-normal precipitation, but the southwestern region of the state has slightly lower odds (33 to 40% chances).

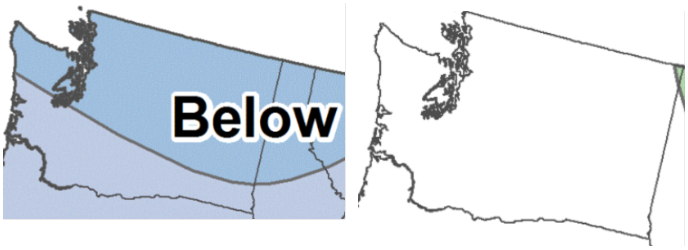
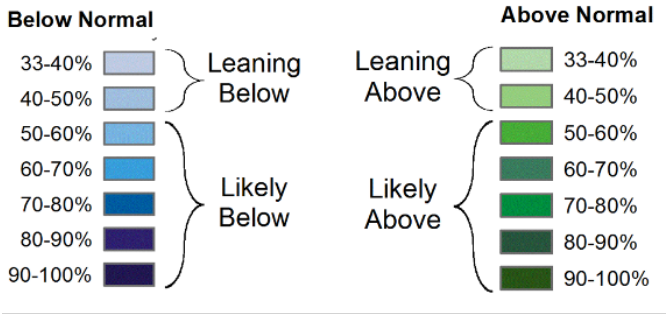


Figure 8: February outlook for temperature (left) and precipitation (right).



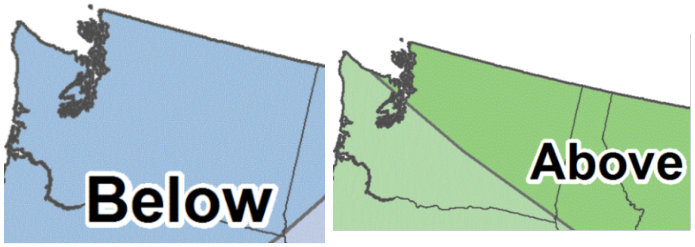


Figure 9: February-March-April outlook for temperature (left) and precipitation (right) (Climate Prediction Center).